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POWER

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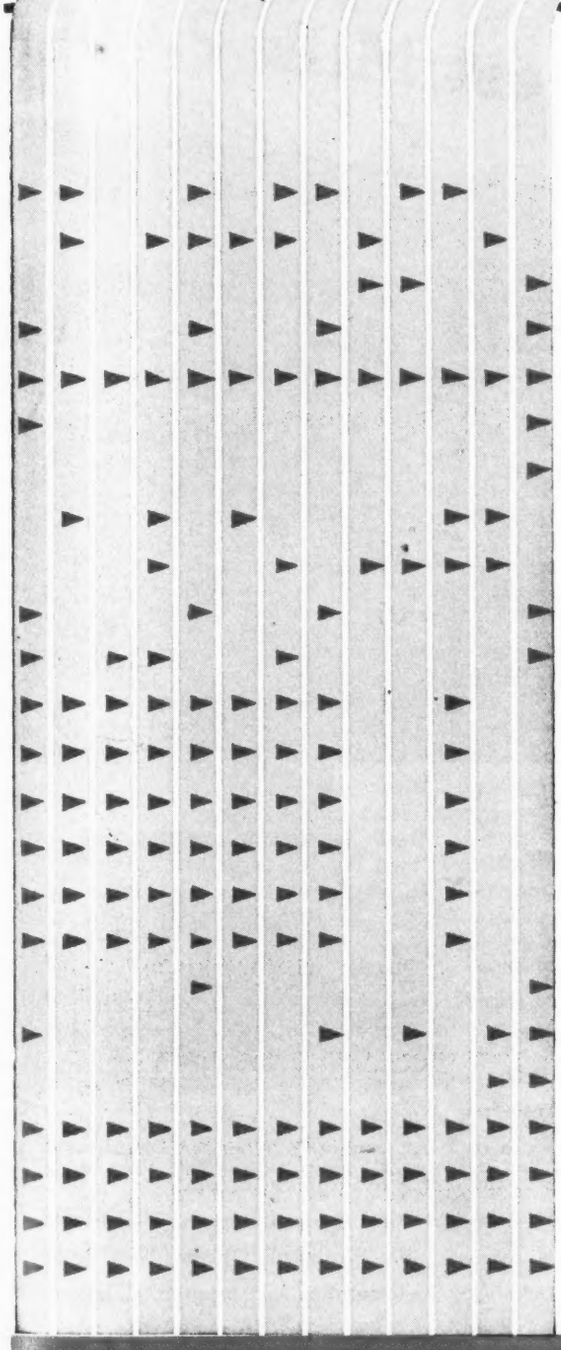

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CALL THE ROLL OF AMERICAN INDUSTRIES

Borden's use BYERS WROUGHT IRON in America's Largest Milk Plant

● Experiences of 80 years are combined in this new Borden's Riverside plant and especially interesting is the experience of Borden's engineers in selecting pipe materials for the various services. Since this new plant was designed to be the most economical in the United States, it is interesting to note that Borden has used and continues to use Byers Wrought Iron for many corrosive services.

Illustrated is the spray pond on the roof which permits economy in the use of water for ammonia condensing and air conditioning. The pipe is Byers Wrought Iron. Also Byers Wrought Iron was used in this plant for caustic soda water lines, soil, waste and floor drainage, vertical vents and gasoline equipment lines.

When you are repairing or planning new construction, consider Borden's experience with Byers Wrought Iron before selecting material for corrosive services. For additional experience in the use of wrought iron and as a guide to the many services where wrought iron gives lower cost-per-year, we refer you to our latest illustrated bulletin, "101 Uses for Wrought Iron." Ask our nearest Division Office or write

our Engineering Service Department in Pittsburgh for a copy.

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BYERS GENUINE WROUGHT IRON Tubular and Flat Rolled Products

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POWER
ESTABLISHED 1882

PHILIP W. SWAIN
EDITOR

Year End

AS THE YEAR draws to a close, let's review 1937 and then take a squint at '38.

All things considered, 1937 hasn't been half bad. There has been plenty of work for designers and operators. Utility loads have risen well above the unprecedented peaks of 1936. We've had quite a bit of central station expansion, though it's a mighty small slice of the new capacity really needed to take care of new load. Meanwhile the curve of industrial-plant modernization has continued its climb.

With few exceptions, manufacturers of power equipment have been very busy. Through most of the year, orders for large boilers and turbines have practically swamped the builders of such major units.

But work has been steadier than orders. In mid summer the demand for certain non-consumer products, notably steel, began to quiet down. And in October, when the frost was on the pumpkins, a sudden stock-market slump revealed frost-bitten confidence as well. The rosy optimist of last spring whispered his fears of "another 1932" and such like.

Now *Power* does not pose as an authority on general business, but readers may be interested in our view of the situation, based in part on our own first-hand study of the power field and in part on the comments of competent general-business advisers.

Here is our story, in plain every-day language: First, the "back to 1932" talk is merely another case of the Wall Street jitters. Rest and proper diet will cure it. No matter what the "big board" may say about a favorite stock, remember that the average citizen is more interested in "room and board" and has a 70 billion dollar national income to spend for it, as against 35 million in 1932.

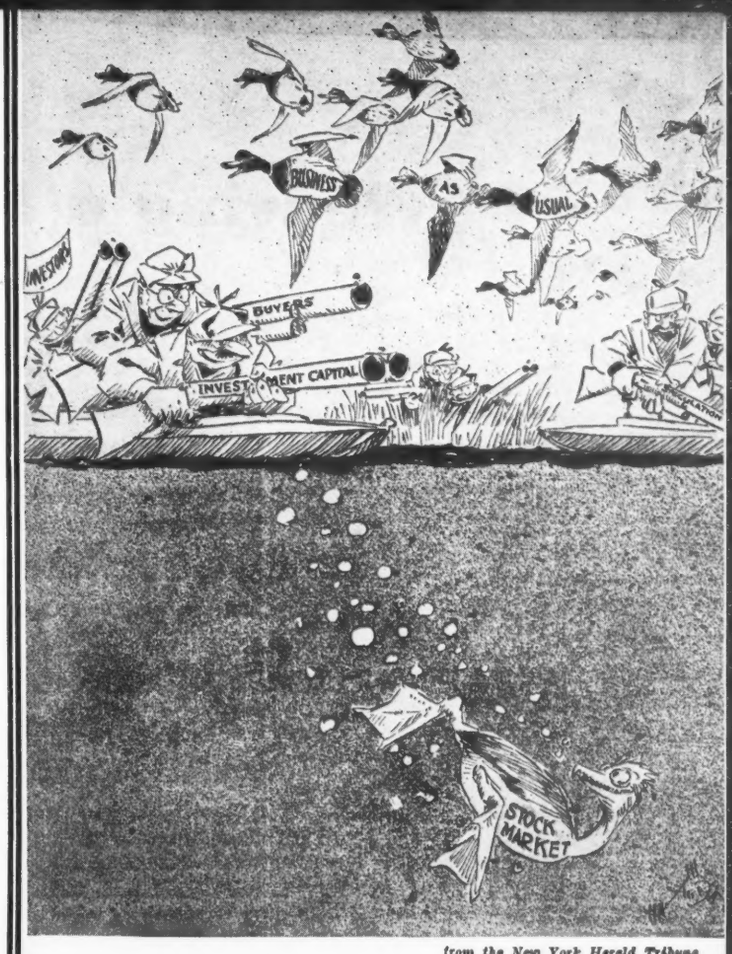
Granting no "depression", will there be a "recession"? The answer is "yes". In fact we are already in it and on our way out.

How long will it take to get out? About as long as it takes to squeeze the fat out of an inventory. Picture it this way: At the receiving end of the production line you have the steady pull of the ultimate consumer spending the national income. Between him and the producer of goods to be processed (sheet steel, for example) stands the manufacturer of consumer products. This manufacturer has a flywheel; he calls it his inventory. When he thinks prices are going up (as he did last Spring) he orders ahead of current needs. When he sees a cloud on the horizon, he sits tight and lives off his fat.

This can last as long as the inventory lasts, no longer. Chalk your calendar for a date early next year for this situation to clear itself.

Now when one man starts to order, prices strengthen and the next rushes in to get his too while the getting is good. So you have another upward spiral. How long will it last? We won't know, but advisers we can trust hint that business will be more than good in the latter half of '38—in fact that we may expect a considerable boom, with rising prices, a seller's market and all the other symptoms. This same source suggests that prudent business men will find the next six months a unique opportunity to get plant additions and improvements under way while prices are still moderate and deliveries within reason.

And one more point. In September we said that the case of those who insist there is no danger of a power shortage by the end of 1938 lacks convincing proof. We repeat it today, and more strongly, because capacity has slipped back another lap in the race with load. The kilowatt, like love, is blind. It cannot read the stock quotations, but responds rather to man's elemental need for light, heat and power, and his ability to pay for them.



from the New York Herald Tribune

"Watching for the Hell-diver to come up"

Weaving a Power Pattern at Olson Rug

How heating and power loads were balanced at Olson Rug & Carpet Co's new power plant containing two 38,000-lb-per-hr boilers at 275 lb and 650 F and three turbine-generators totaling 2,375 kw of capacity. Changes in process permitted use of all exhaust from power generation for heating

WHEN ALL POWER for an industrial-plant load can be generated as a product of process and heating steam, the two services may be provided at minimum cost. This is an accomplishment of the Olson Rug Co, Chicago, Ill. This progressive company, the world's largest manufacturer of rugs, carpets and broadlooms dealing direct with the home has done many other things besides building one of the most interesting power plants in this country. Its factory, built almost entirely of glass, is a model for good lighting, ventilation and working conditions. Outside the plant are landscaped grounds containing rock gardens, waterfalls using over 2,500 gpm, rare trees, shrubs, flowers, wild ducks and fish, which make it one of the showplaces of Chicago.

Originally all steam for process was supplied by four stoker-fired boilers at 65 lb g and all power was purchased. When the company's mechanical engineer, E E Higginson, made studies of the plant he discovered that all process and building heating could be done by low-pressure steam if the equipment were correctly designed. Gradually equipment was changed over for low pressure, with the object in mind of installing a new boiler and power plant that would supply all power and heating needs of the manufacturing processes. The change to low-pressure operation increased production and improved its quality.

Plant Extension

In 1934 a large extension to the manufacturing plant was authorized that made the old boilers inadequate to supply the steam requirements. Studies made by Walter E Olson and the company's engineering department showed that with a power plant using back-pressure turbines, practically all exhaust could be used in process. Such a plant would result in a saving, compared to the old method of operation, that would pay for the new installation in approximately 7.5 years. The building program was completed in 1935 and the power plant went into operation in January, 1936. Its performance has surpassed the expectations of the company's engineers.

When designing the plant it was decided that it should be of simple and reliable design, practically automatic in operation, and with high thermal efficiency. As cleanliness is an important requisite in the manufacturing plant, the power plant, which was to burn coal on stokers, also had to be designed practically to eliminate dust from ashes and coal. To this end, the coal and ash system has been so arranged that it is entirely inclosed from the point at which the coal goes into the track hopper until the ashes come out of chutes on rail cars for removal.

Coal Handling

Mine screenings are received in cars and dumped on a grating, with bars spaced 0.75 in. apart, from which it flows into a track hopper. Coal flowing into the hopper automatically closes a switch and starts the coal conveyors and elevator that discharges into the top of 600-ton, reinforced-concrete coal tower. Coal-elevating equipment comprises an inclined conveyor feeding into a loop-boot elevator that lifts the coal 113 ft. and delivers onto a horizontal conveyor which discharges into the coal tower.

These conveyors and elevators are of the Redler type with a capacity of 35 tons per hour, and comprise a series of skeleton U-shaped flights closely spaced upon a conveyor chain, which is pulled through a smooth trough or casing, as in Fig. 5. Material fed into the conveyor will flow forward in a solid column without internal disturbance. Because of the design of the conveyor one might expect that flow of material in it, particularly in a vertical direction, might not be constant. It has been found at the Olson plant that flow is so nearly uniform that a speed counter on the drive shaft can be used as an accurate means of weighing the coal that checks with the car weight.

Coal Tower

The coal tower may be considered a vertical bunker, because of its length, 85 ft, and capacity, 600 tons. Constructed of reinforced concrete, it is rectangular in cross-section, 18x15 ft, this cross-section being selected after tests on models showed that it was least subject to arching. Experience during nearly two years of operation verifies the test results.

Coal discharges from gates in the bottom of the bunker into a horizontal and inclined 5-ton-per-hour Redler conveyor that delivers it into a dust-proof hopper above the boiler fronts. From there it flows through a chute into the stoker hoppers, which are fitted with dustproof hoods, Fig. 4. Coal feed from the bunker is controlled automatically by a switch operated by coal level in the hoods on the stoker hoppers. This device includes a coal-level indicator to show the operator if coal level is low in the hopper, if for any reason the conveyor fails to start when the switch closes. A revolution counter on the conveyor driveshaft is used to obtain coal weight delivered to the stokers. A close check is obtained between coal weighed into bunker and that delivered to stoker.

Ash Handling

Ashes are dumped from the stokers into a hopper 8 ft below the grate line. From this hopper they discharge into an enclosed ash tower, adjacent to the coal tower, by a steam jet conveyor. This tower is 18x6 ft inside cross-section and has a capacity of two carloads of ashes. The tower is set at a level so that ashes are discharged

directly by gravity through two chutes into cars on the coal track. The chutes are equipped with automatic sprinklers that discharge water through their sides into the ashes as they come from the storage tower. This sprinkling completely eliminates dust when loading the ashes and a 50-ton gondola car can be loaded in about 10 min.

To further eliminate dust and dirt the stack is equipped with an electric-eye smoke detector. This detector sounds an alarm when smoke of even a low density is present and records the duration of the violation and its density.

Two 4-drum, bent-tube boilers, Fig. 1, each having 4,350 sq ft of steam-making surface, supply steam at 275 lb g and 650 °F total temperature. These steam conditions were selected as being the most practical and economical for the manufacturing processes and power requirements. Each boiler is fired by a double-section sprinkler stoker with steam-operated dump grates, in a furnace of 1,135 cu ft volume. Only the rear wall of the furnace is water cooled; the other walls are of refractory construction without artificial cooling. Stokers are designed to operate the boilers at 200% rating continuously and peak loads up to 250% when burning Illinois strip-mine screenings.

Fuel Burning

With this type of stoker, the fine particles of fuel are burned in suspension and the coarse on grates. It employs the overthrow method of feeding coal, which gives a uniform thin fuel bed over the grates without segregation of fine and coarser pieces. Only about a 3-min. supply of fuel is carried in the furnace, consequently a boiler can be quickly taken out of service to reduce banking losses. The grates are built up of comparatively small sections of cast iron of special design, mounted on dumping shafts actuated by steam power cylinders. Each stoker is divided into two sections, either of which may be cleaned while the other continues to operate at full capacity.

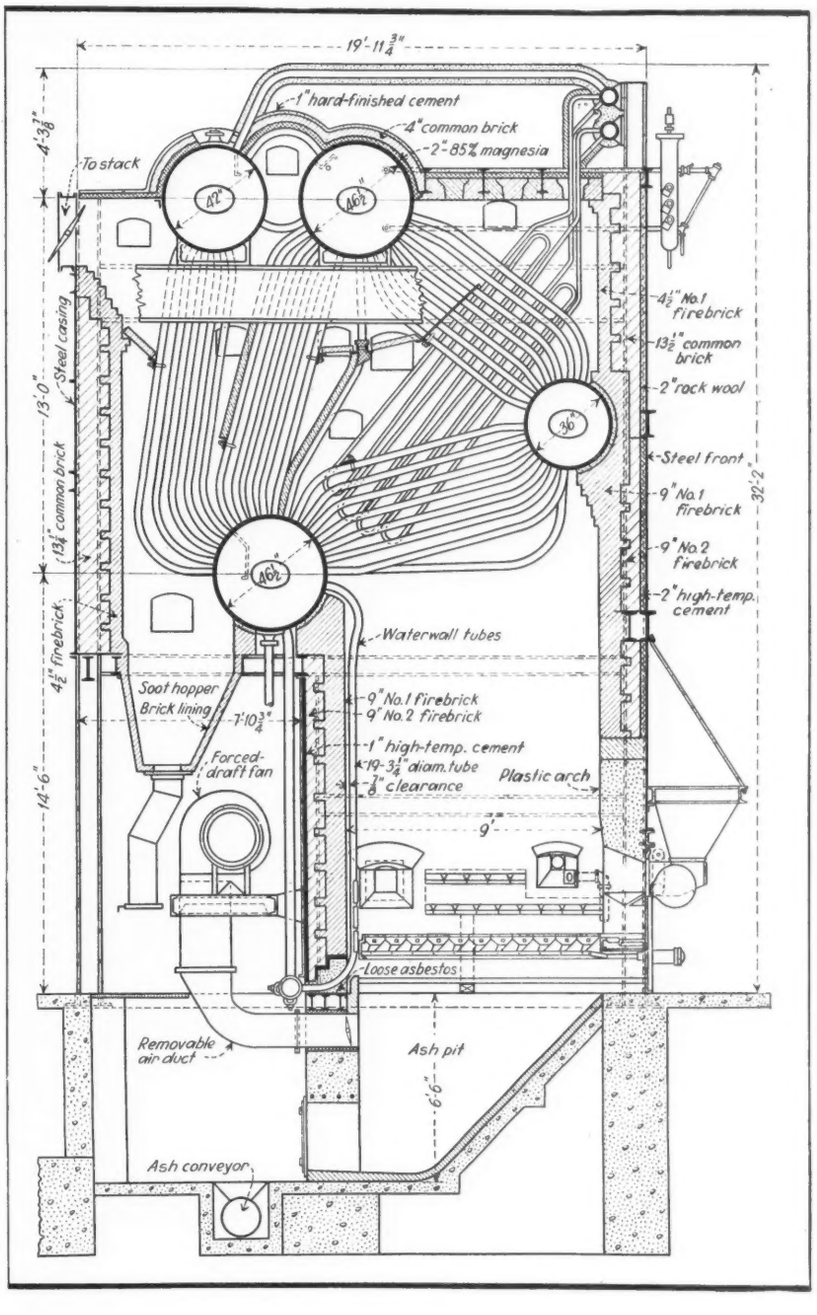
Draft is provided by a squirrel-cage motor-driven forced-draft fan with vortex control on each boiler and a brick and concrete stack 185 ft high and 10 ft in diameter at the top. A high stack was selected, in preference to a shorter one and induced-draft fans, to eliminate any nuisance from the stack discharge.

Control of the combustion process is automatic. A regulator receiving its initial impulses from steam pressure regulates stoker speed and uptake damper position. A furnace-pressure regulator maintains constant furnace pressure by vortex control of the forced-draft fan. The combined action of forced-draft and furnace-pressure regulators adjusts air flow in proportion to fuel feed to maintain high operating efficiency. A CO_2 indicator gives a check on combustion-process efficiency.

Because so much low-pressure steam is used directly in process, boiler feed contains at times as high as 80% makeup. In spite of this, by proper treatment of the feedwater, the boilers and the turbines have remained practically clean. Feedwater treatment consists of reactive colloids together with an anhydrous-phosphate adjunct and sodium sulphate. The latter maintains sulphate-carbonate ratio to prevent caustic embrittlement, according to ASME standards. The treatment is fed continuously through an auxiliary chemical proportioning pump from a solution tank and introduced at the boiler-feed pump.

Boiler water and boiler feedwater are analyzed daily and treatment regulated according to analysis to maintain specified chemical balances in the boiler water. This plant control is supplemented with periodic visits by an engineer from the laboratories in control of the treatment employed and additional detailed laboratory analysis of boiler feed, boiler water and condensate. Boiler concentrates are controlled by continuous-blowdown system

Fig. 1—Each of two sprinkler-stoker fired boilers is set over a furnace having a volume of 1135 cu ft



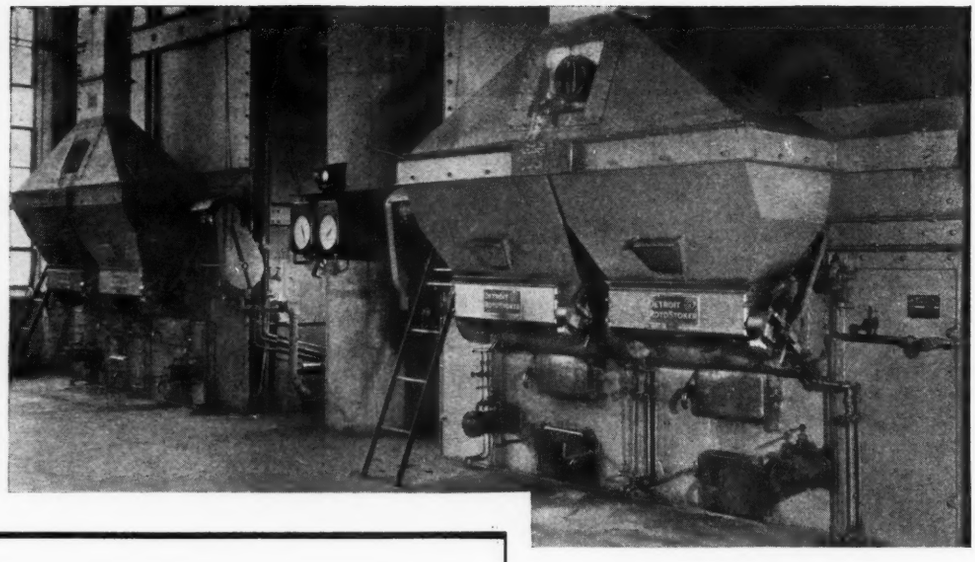
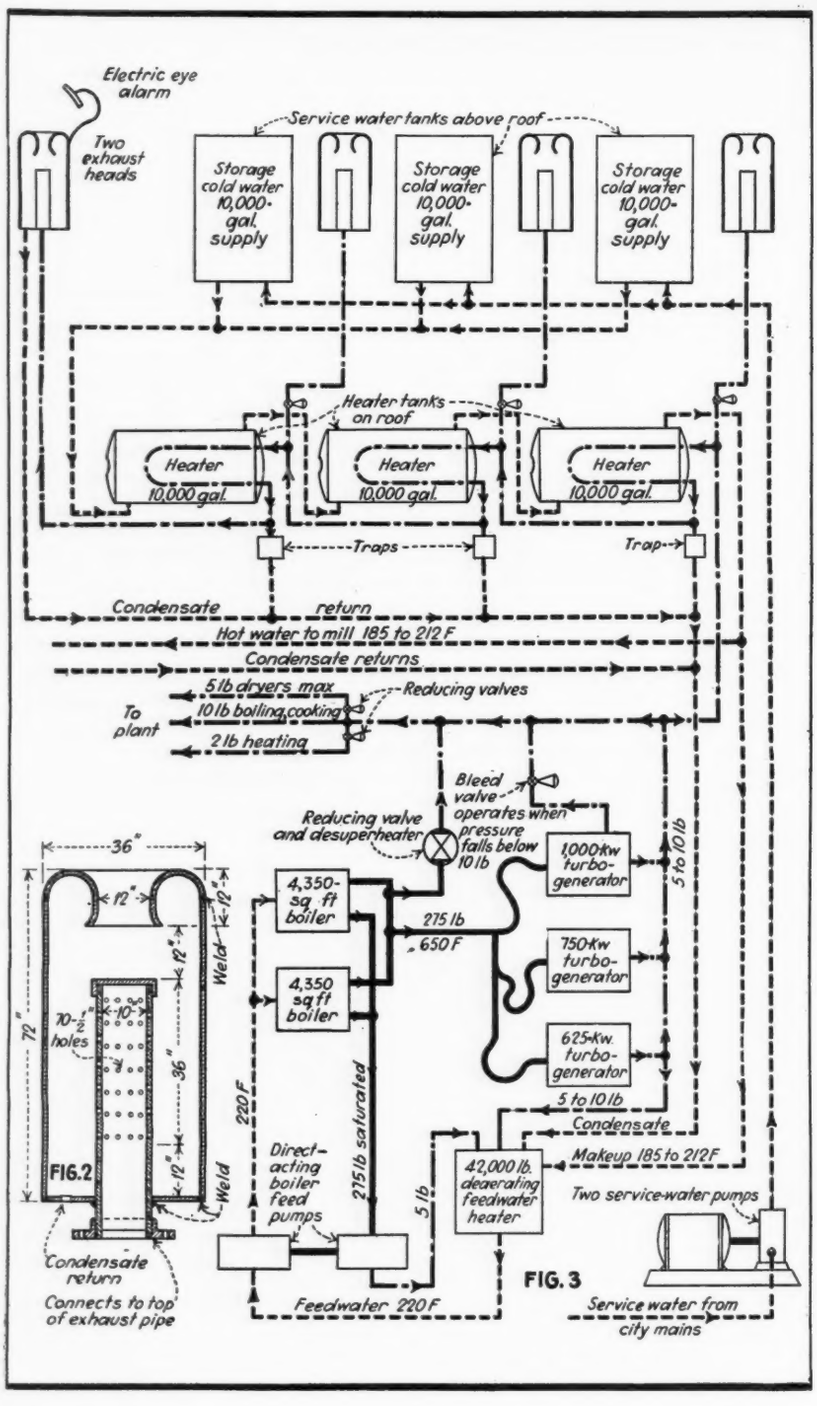


Fig. 2—(below)—Cross section of exhaust head. Fig. 3 (below)—Hookup diagram of power-plant equipment and water-heating tanks on plant roof. Fig. 4 (right)—Stoker hoppers inclosed with dust-proof hoods, which eliminate all coal dust in boiler room.



In the turbine room, separated from the boiler room by a glass partition, power is generated by a 625-kw and a 750-kw, 1,200-rpm alternator, each geared to a backpressure turbine operating at 4,900 rpm. Backpressure on these turbines is varied from 5 to 10 lb. A third unit comprises a bleeder-type backpressure turbine direct-connected to a 1,000-kw, 3,600-rpm generator. This turbine is arranged to bleed at 25 lb g and exhausts at 5 to 10 lb g.

From this turbine steam is bled at 25-lb and it exhausts into the duo low-pressure header as do the other turbines, as shown in Fig. 3. The pressure in this header is adjusted by control of the 25-lb bleed to prevent exhaust going to atmosphere or high-pressure steam being taken through the desuperheater into the low-pressure system.

Heating Tanks

The exhaust header connects to three 10,000-gal heating tanks on the plant roof. These tanks are connected in series both for heating steam and water flow through them, for counterflow heating. Effort is made to use all excess exhaust steam above process and building-heating demands in these tanks. Because of the small amount of exhaust escaping from the water-heating coils at any time and the design of the exhaust heads, Fig 2, most exhaust condenses and returns to the feedwater heater.

A thermostatic alarm is connected to the high-temperature tank and set to ring a bell when the water temperature reaches 212 F or drops to 185 F. When the high-temperature alarm sounds it indicates that there is an excess of exhaust. To correct this, backpressure is reduced on the turbines by adjusting the bleed valve, so

that they will take less steam for power generation. If the low-temperature alarm sounds, it indicates a deficiency of exhaust steam. To correct this, backpressure is increased on the turbines.

Backpressure on the turbines can be adjusted over a range of 5 to 10 lb. When process- and heating-steam requirements cannot be supplied with the 25-lb bleed valve on the 1,000-kw turbine wide open, the deficiency is provided from the high-pressure line through a reducing valve and desuperheater, which functions if the backpressure drops below 5 lb.

For over 80% of the time process and heating-steam demands exceed exhaust from the turbines when generating the power load against 10 lb backpressure. For a large part of the remaining time the amount of exhaust available can be kept within process and heating requirements by adjusting the backpressure on the turbines. As a result power costs are very low when proper credit is given for heat in the exhaust going to process and heating. Whether power was generated or not a new boiler plant would have been required for the enlarged manufacturing plant.

As already mentioned the coal is weighed. In addition steam is metered and meters provided for obtaining other quantities so that the plant can be operated under practical test conditions at all times. During 1936 an average boiler and furnace efficiency of 78% was obtained, with 8-hr operating efficiencies as high as 82%.

The power plant architecture harmonizes with that of the main building. Inside the plant a pleasing, roomy and convenient-to-operate arrangement of equipment prevails. All piping is welded and placed in steel-plate covered trenches in the floor. Absence of piping adds much to the appearance of the plant. So many of the operations have been made automatic that the watch engineer's chief jobs comprise reading of meters, keeping the log hourly and making small adjustments if operation deviates for best efficiency, due to atmospheric or fuel-analysis changes or sudden operating-schedule changes.

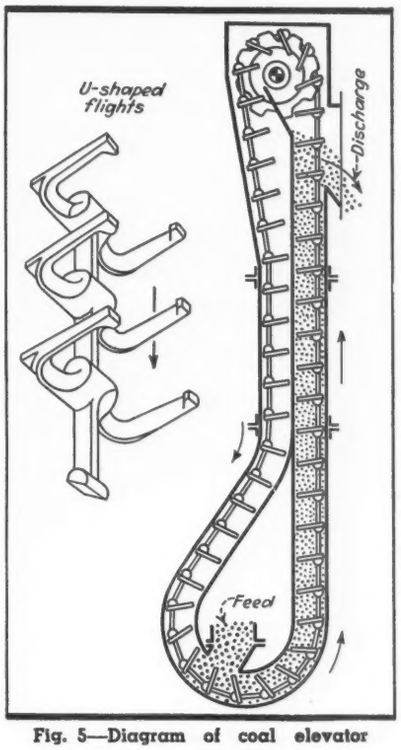


Fig. 5—Diagram of coal elevator and section of U-shaped flights

PRINCIPAL EQUIPMENT IN POWER PLANT *Olson Rug & Carpet Company*

General Contractor.....Lundoff Bicknell Co
Architects ..... Weiss & Neiststadt
Engineers.....Walter E Olson and eng staff
Boilers, waterwalls and superheaters.....Wm Bros Boiler and Mfg Co
Boiler heating surface, 4,350 sqft; waterwalls, 300 sqft; Max continuous steaming capacity 38,000 lb per hr; working pressure, 275 lb g; total steam temperature 650 F; furnace volume 1,135 cuft; max Btu liberated per cuft per hr 48,500; superheater, 710 sqft.
Boiler and furnace settings.....Warwick Co
Arches.....Plibrico Jointless Firebrick Co
Boiler heat insulation.....Warwick Co
Boiler heat insulation.....Owens Illinois Glass Co
Boiler ducts and breachings.....McAllister Boiler Works
Boiler casings.....New City Steel Works
Stack, concrete 185 ft high, 10 ft dia.....Continental Chimney Co
Structural steel .....New City Steel Works

Combustion Equipment:
Automatic combustion control .....A W Cash Co
Furnace-draft regulator .....Ruggles-Klingemann Mfg Co
Sootblowers .....Bayer Co
Stokers, two, sprinkler type.....Detroit Stoker Co
Stoker drive, type 1.5-hp squirrel-cage motors.....Louis Allis Co
Coal-level indicators .....Bin-Dicator Co
Forced-draft fans, 2 double-inlet.....Clarage Fan Co
Forced-draft fan motors, squirrel-cage.....Louis Allis Co
Motor starters ..... Cutler Hammer, Inc
Coal-handling equipment, Redler conveyor..Stephens-Adamson Mfg Co
Motors on coal-handling equipment.....Master Electric Co
Coal and ash bunkers.....Lundoff Bicknell Co
Ash-handling equipment ..... United Conveyor Co
Flyash return blower ..... Buffalo Forge Co

Valves:
Safety valves ..... Crane Co
Blowdown valves ..... Okadee Co
Non-return valves .....Edwards Valve & Mfg Co
Non-return on turbine bleed lines.....Edwards Valve & Mfg Co
Automatic stop valves on turbines.....Atwood & Morill Co
Stop and check valve in feed lines.....Edwards Valve & Mfg Co
High-pressure valve ..... Crane Co
Low-pressure check valves, non-return.....Crane Co
Reducing valves and control system.....Atlas Valve Co
Asmospheric-relief valve, 8 in.....Atlas Valve Co
Atmospheric relief valve, 6 in.....Klipfeld Mfg Co

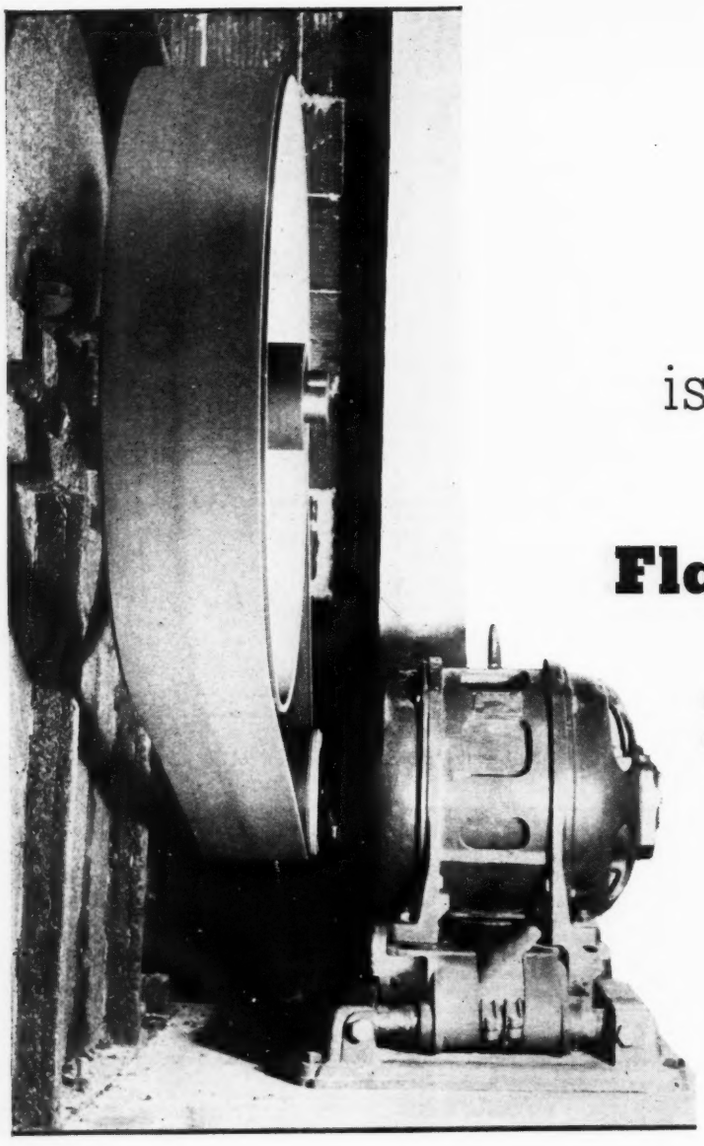
Piping, Traps and Strainers:
Pipe, wrought iron.....A M Byers Co
Piping contractor ..... Gordon Engineering Co
Pipe heat insulation, Ehret ..... Gordon Engineering Co
Low-pressure piping.....Taylor Forge & Pipe Works
Traps and strainers.....Boylston Eng Co

Feedwater System:
Water columns ..... Yarnall Waring Co
Feedwater regulator, excess-pressure regulator and feedwater pressure-control governor ..... Swartwout Co
Boiler-feed pump, simplex, double-acting.....Union Steam Pump Co
Boiler-feed pump, duplex, double-acting.....Am. March Pumps Inc.
Feedwater deaerating heater.....Stickles Steam Specialty Co
Feedwater treatment .....W H & L D Betz

Pumps and tanks:
Service-water pumps.....Wesco Pump Co
Condensate return pumps.....Dayton Dowd Pump Co
Vacuum pumps .....Union Steam Pump Co
Sump pumps .....Weil Pump Co
Service cold-water tanks.....Chicago Boiler Works
Service-water heater tanks.....Chicago Boiler Works
Service-water heaters.....Lambert Co
Service-water temperature alarm.....Marshalltown Mfg Co

Meters:
Steam-flow meters .....Cochrane Corp
Feedwater-flow meters .....Buffalo Meter Co
CO_2 indicators .....Hays Corp
Draft gages .....Hays Corp
Steam-pressure gages on boilers .....James P Marsh Co
Steam-pressure gages on turbines
Consolidated Ashcroft Hancock Div
Manning, Maxwell & Moore
Turbine-speed indicator .....James H Biddle Co
Thermometer, industrial .....Taylor Instrument Cos
Thermometers, indicating .....Taylor Instrument Cos
Temperature recorders ..... Illinois Testing Corp
Atmospheric temperature recorder ..... Bristol Co
Flue-gas analyzer ..... Hays Corp
Smoke-density indicator and recorder...McNeill Engineering Equipt Co

Power-Generating Units:
One 750-kw and one 625-kva 4,900-rpm non-condensing turbine each geared to generator ..... Murray Iron Works Co
Throttle conditions 275 lb g, 650 F total temp, exhaust 5 to 10 lb g backpressure
Generators, 1,200 rpm, 240 volts, 3-phase, 60 cycles, 80% power factor ..... Crocker Wheeler Co
One 1,000-kw, 3,600-rpm non-condensing bleeder-type turbine; bleed 25 lb g and exhaust at 10 lb g.....Murray Iron Works Co
Direct-connected generator with exciter and air cooler
General Electric Co
Air-cooler water pump ..... Wesco Pump Co
Pressure regulator on governor oil ..... Fisher Governor Co
Couplings between turbines and generators, Fast
Bartlett Haywood Div, Koppers Co
Switchboard.....Marquette Electric Co
Switchboard instruments.....Weston Elect Instrument Co
Voltage regulator ..... Electric Service Engrg Co
Oil switches ..... Condit Electrical Mfg Co
Electrical contractor ..... Henry Newgard & Co
Signal Systems ..... Benjamin Electric Co
Air Compressors ..... Ingersoll-Rand



Overload is the bugbear of **Flat-Belt Drives**

Coefficient of friction overload capacity and other operating characteristics

Fig. 1—A 25-hp motor connected to a large exhaust fan by short-center flat-belt drive. Motor mounted on base to automatically maintain correct tension in belt

OVERLOAD CAPACITY is one of the most important requirements in a good belt-drive. Other things being equal, it depends upon characteristics of the belt and kind of load. Two belts of equal rating at the same initial tension may have very different overload capacities, because of inherent differences in coefficient of friction.

Much has been said about coefficient of friction, but just how it influences belt performance is not generally appreciated. Frequently, belts having high coefficient of friction are overloaded, in the mistaken idea that because the belt "takes it", everything is all right. Conservative shop practice rates leather belts of equal width and thickness at a standard capacity, although some may have much more ability to carry overloads as a result of higher coefficient of friction.

The curves, Fig. 2, show the result of tests on three different belt groups in a laboratory that has tested a large number of belts. These tests were made on belts 3 in. wide at 2,500 fpm and an initial tension of 250 lb per sq in. of belt cross-section. Both belt speed and initial tension are conservative. A single-ply leather belt 3 in. wide, running 2,500 fpm, has a normal capacity of about 10 hp. It will be seen that at this load, each belt has a combined slip and creep of about 0.75%.

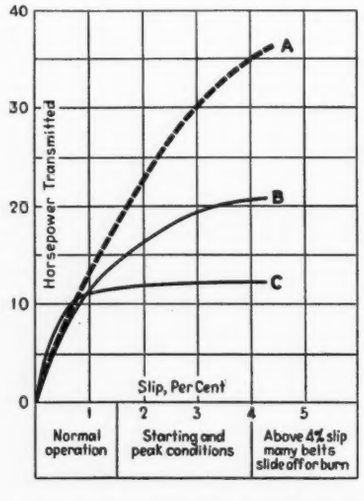


Fig. 2—Results of load and slip tests on three groups of belts. Initial tension 250 lb. per sq in.; belt speed 2,500 fpm; all belts 3 in. wide

It is interesting to note that at 10-hp load, Grade *A* belts with the highest overload capacity and Grade *C* belts with the lowest have lower slip than Grade *B* belts having medium overload capacity. At less than 10-hp load, the belt with the least overload capacity has the lowest slip. This is, however, of small consequence compared to how the belt acts under overload.

Assume that the belts were called upon to take a peak load of 20 hp. Grade *A* belt can do this with about 1.7% slip, Grade *B* slip about 3.4% and Grade *C* belt will probably come off its pulley. Grade *C* belt can be made to carry the load by increasing its initial tension, but the increased initial tension remains whether the belt is operating without load or taking a peak. On the other hand, the high coefficient-of-friction belt can operate at low initial tension and still have sufficient capacity to transmit peak loads at comparatively low slip.

Excessive initial tension in a belt reduces its life because of overstress of its fibers and because of increased internal heating. It also causes excessive stretch and makes frequent shortening necessary. Bearings are overloaded, thereby preventing proper lubrication, causing undue wear and reducing efficiency.

Don't Overload Continuously

Because a belt with high overload capacity at normal tension can take an occasional overload without injury, it should not be continuously overloaded by taking peaks of pulsating or intermittent loads. Characteristics of the load must be taken into consideration and proper allowance made in designing a belt drive, no matter what type it may be. If this is not done, short belt life and unsatisfactory service may result. Because of its greater overload capacity at normal initial tension, a belt with high coefficient of friction will have longer life and operate with less slip under severe conditions, which means more production than with a belt of less overload capacity.

This discussion is not an attempt to present a case for or against any type of belt, but is a reminder that belt characteristics should be given careful consideration in applying them. In the absence of such information, play safe and be sure to select a belt large enough for the drive. When properly used, a 15-hp belt on a 10-hp load will pay for the excess capacity several times in increased life, reliable service and efficiency, where an undersize belt will be a source of expense and unsatisfactory operation.

Radio Knits
the Elevator System

By William Devaughn

COORDINATION on large elevator installations means quick and convenient communication between the chief mechanic and workers on various parts of the system. In the Bank of Manhattan Bldg., New York, N. Y., this is accomplished by a system of loud-speaker phones.

Five master phones are in the elevator-operating room, where an attendant is always on hand. Twenty remote phones (four to each master unit) are located about the building. An old roll-top desk, Fig. 3, was brought out of retirement to serve as a housing for the five master phones. In addition, each master phone has a volume control, a selector switch and a control switch. The selector switch permits calling all four remote phones individually or at the same time. The control switch has two positions, "Listen" and "Talk". Normally, this switch remains in the "Listen" position so that the attendant in the master-phone room can be called from any of the remote phones.

Remote phones are in each of five machine rooms (the master units are in the sixth), also in rooms where secondary sheaves and other equipment are located, and in dispatchers' cabinets in each elevator corridor on the ground floor.

Not only do the phones immediately put all important locations in contact with headquarters or vice versa, but they permit an attendant to be away from the remote phone in making a call. This is very desirable in case of trouble and in a way is a real safety feature. Likewise, a call sent from the master to its four remote phones can be heard some distance from these phones. As a result, the time element has been practically eliminated in this communication system, and at the same time, attendants are given a great deal of freedom to carry out instructions, particularly in emergencies.

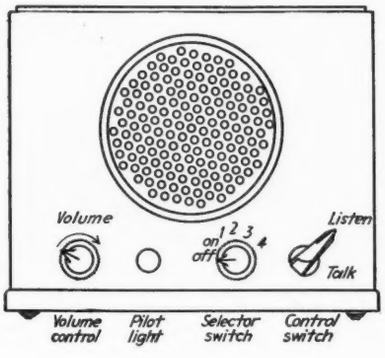


Fig. 1 (lower left)—Front view of master phone for 2-way communication

Fig. 2 (right)—Remote phones are placed at strategic points in motor rooms and other locations for workmen

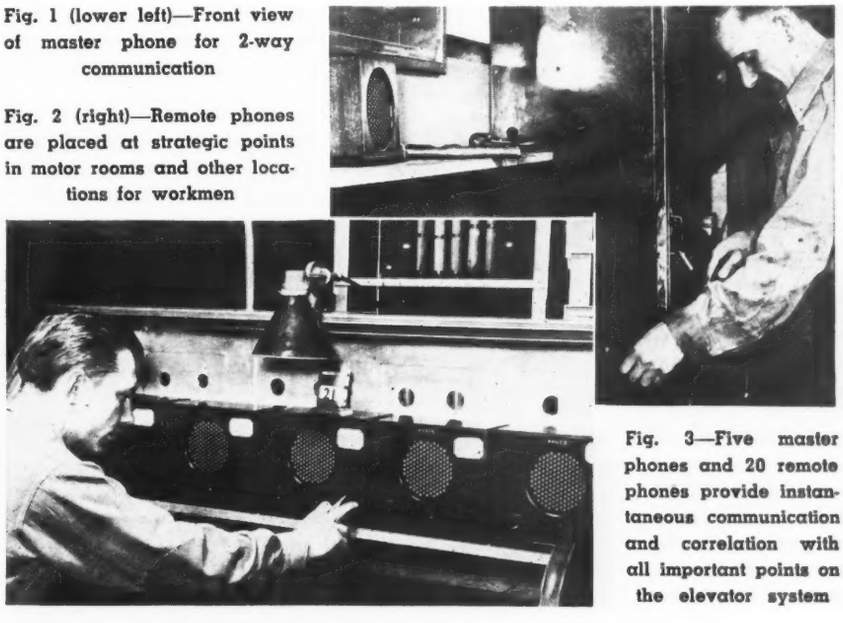


Fig. 3—Five master phones and 20 remote phones provide instantaneous communication and correlation with all important points on the elevator system

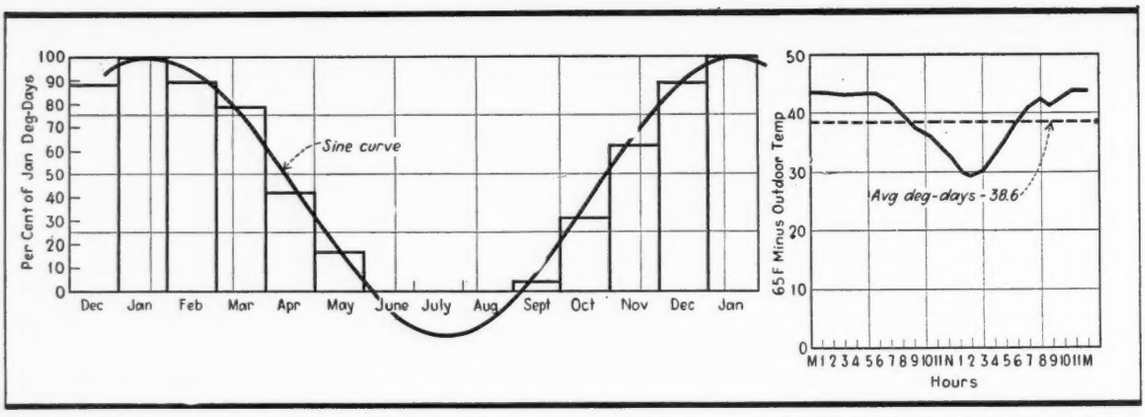


Fig. 1—20-year average of deg-days for Detroit closely represented by a sine curve

Fig. 2—Deg-days for a typical winter day

Make your own curves

For Hotel Steam

The second half of a survey on the steam use of 40 hotels, telling how to draw useful load curves

By Charles I Sayles
ASSISTANT PROFESSOR OF HOTEL ENGINEERING, CORNELL UNIVERSITY

IN THE FIRST HALF of this article, the steam use of hotels was averaged from a study of 40. A constant, 0.97 lb of steam, was developed for heating per degree-day per 1,000 cu ft. For other services, 4,800 lb of steam are used per occupied room per month.

It isn't enough to know how much steam a hotel uses. Other factors, such as whether or not a hotel generates its own power, include a fair idea of what time of day high and low demands occur and about how large a demand the boiler plant may have to carry. Also useful as a "bogey" is a curve of monthly steam consumptions for a normal year.

Generalized Curves

A great degree of accuracy for general curves intended to apply to no specific hotel is not necessary or even desirable. While the methods I have used are open to question in some details, the resulting curves are a pretty good indication of how the average hotel runs. By following the outlined methods and making definite allowances for known variations, you can develop a quite accurate set of curves for any given hotel.

First, weather conditions for the locality are the most important data to have on hand. Remember that the local Weather Bureau maintains such records and is pleased when people ask for them. Typical of such data, Fig. 1 is a plot of Detroit degree-days per month average over twenty years. For convenience I have plotted the percent variation and then fitted an ordinary sine curve to the data, letting it extend below zero. Note how well the sine curve represents the facts, showing on the negative side the need for cooling for air conditioning.

Now, for a hotel of known size, calculate the steam use at 0.97 lb per deg-day per 1,000 cu ft and add 4,800 lb per occupied room per month. This will give a satisfactory general curve of monthly variation in total steam use. Correct the figures to allow for more or less laundry service and special catering if you like.

In figuring the daily load variation, it is good practice to select a day typical of each heating season, fall, winter and spring. If you wish, fall and spring can be represented by the same day, the error introduced not being great. Fig. 2 shows hourly temperatures subtracted from 65 F for a sample winter day. This day represents 38.6 deg-days, or an average outdoor temperature of 26.4 F, and will require 0.97 lb x 38.6 deg-days, or 37.5 lb of heating steam per 1,000 cu ft. Instead of an average of 1.56 lb per hour over the 24-hr period, steam demand is obviously lower at night and greater during the day.

In setting up the steam-use curve for this sample day, I have arbitrarily assumed that 20% of the building will be devoted to general use and will therefore be heated at night by only 20% of the steam that would be required by the night temperatures between the hours of 2 and 6 AM. However, from 8 AM to 2 AM, the building will be kept at 70 F instead of 65 F as assumed for average conditions on the deg-day basis. Therefore, the daytime and evening demand has been increased by 5 deg over the average of 38.6 or 13% more than the temperature would seem to require. The resulting curve is shown in Fig. 3, with the early morning hours from 6 to 8 AM increased just sufficiently to total 37.5 lb for the entire day and night period.

Shape Varies

While the shape of this curve is bound to vary somewhat, depending on the size of the boiler plant in relation to the size of hotel, and more particularly on the means of temperature control in guest rooms, the method of construction is sound and is easily adapted to suit known local conditions. An actual case is shown

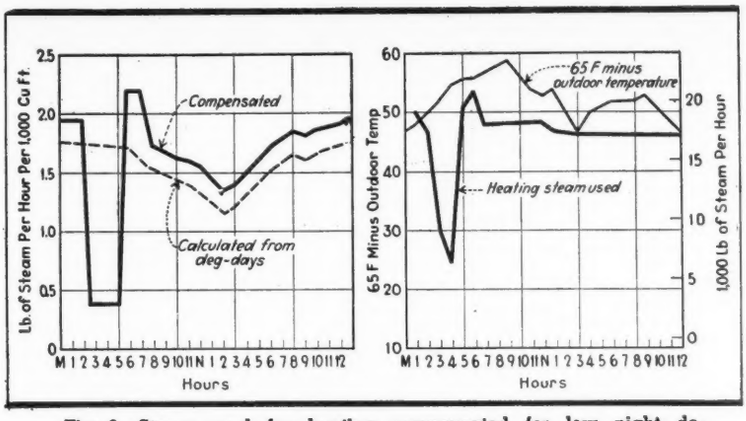


Fig. 3—Steam used for heating compensated for low night demand. Fig. 4—Steam used for heating one of the hotels surveyed

in Fig. 4 for comparison with the developed curve. Other typical curves for more moderate and more severe weather conditions can be prepared on the same basis, and for more complete study of a particular case, curves for Sundays, convention periods or other special occasions are handy.

Several interesting discrepancies have turned up in the data on the 40 hotels. For instance more steam seems to be used for heating water in the summer, although one would expect less to be used when the water supplied is warmer. Perhaps warm weather increases the number of baths. Some other wide deviations from the average heating requirements might be traced to temperature control of guest rooms, sometimes conspicuous by its absence. Hotels which purchase steam use less than those which have their own plant. Perhaps the presence of a steam meter has a thought-provoking influence on the management. Figures given in this article, however, are averages of quite different types of hotels and predictions based on them are quite as likely to err in one direction as another, the best that can be secured from a general analysis of several individual cases.

Exhaust Lines

By E J Tangerman

Reports of successful trial runs by a new type of semi-diesel-engine-powered locomotive come from Humbolt-Deutz-Motoren A G, large German maker of diesels. It is claimed that the method of operation of the locomotive is entirely new in having direct drive wheels without gears. The machine is reported to have developed 66 mph. Air from a compressor operated by an auxiliary diesel is admitted into the cylinders of the locomotive to start the engine. Pumps then throw a fine spray of fuel oil into the cylinders, ignited by electrically heated metal spirals. As soon as the locomotive has gained medium speed, the compressed air is shut off. The locomotive develops a maximum of 1,000 hp.

One central station took to testing its safety valves at night. Residents 'round about, who all worked at a large adjacent manufacturing plant, complained to their superiors that the pops wakened them. So the power plant now tests safety valves during the day—in competition with the manufacturing plant's tests of sirens.

B-r-r-r-ing! And a certain central station stages its periodic fire drill. A new operator, not to be outdone, comes rushing to the spot with a big extinguisher. After the drill, he starts to carry it back to its place, but it grows too heavy. Unthinkingly, he swings it up on his shoulder. Well, you know what happens when an extinguisher of that type is inverted. This one worked exactly as it should, spraying the whole area until the startled operator muffled it with wiping rags and ran for a slop sink. They say the plant superintendent is still trying to find out why one recently inspected extinguisher was found empty a few days later.

William H Burger, a New York teacher who has a bungalow in Pleasant Valley, near Harrisburg, Pa., recently complained to the Penna. Public Service Commission about powerplant soot thuswise: "You can hear the soot falling on the leaves and bushes, and worse than that, it itches your neck." Imagination, to say the least.

Talking of operating lingo, have you heard of "Molly-be-damned", with the accent on the last syllable? It's the engineer's name for a molybdenum ore, now being used for treating coal which seems to have some effect on slag-forming properties of coal and "stickiness" of ash, but nobody is quite sure yet just how it works or how much good it does.

Included in the recent 40-million-dollar expansion plan announced by Ford for River Rouge is a 1,000-ton blast furnace, to cost $4,500,000, The unit will be all-welded, first of its type.

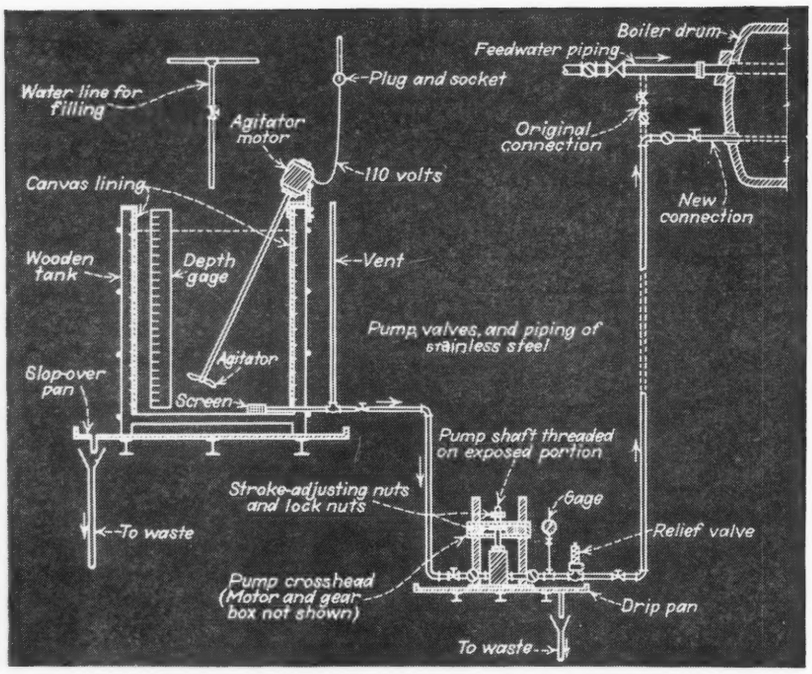
Facts regarding the operation of the first of the diesel engine ships, the M S *Selandia* (now the Norseman), long held secret by Danish authorities, have just been published in this country. Practically all major parts of the ship's motors have been replaced during her 25 years of service. In the first 20 years, all cylinder sleeves were renewed once, and they have been replaced again within the last five. Cylinder covers have been refitted two or three times, and new crankshafts have been installed. Repairs for the year 1926-31 on the main and auxiliary motors averaged about $5,000 annually. Only one major alteration in the original machinery is reported, a change in the two auxiliary compressors. These originally delivered air at 300-lb. pressure to the main containers and the main compressor, in turn, supplied intake air at 900-lb pressure. This system proved unsatisfactory, and a new main compressor now delivers intake air at 900-lb pressure without precompression.

Gold-foil beaters are among the most recent industries to find that air conditioning helps in process. Controlled humidity and temperature result in better, more uniform gold leaf.

Habit is important. Back in 4200 BC, brewing was developed in Babylon. About 600 AD, large copper cauldrons began to be used for making beer in the Caucasus mountains, and the use has persisted. Some brewmasters now think that copper helps the flavor.

Each of the Boulder Dam generators contains something over 28 tons of copper and its alloys alone, to say nothing of the other metals.

After an experiment with dry-ice refrigeration of a carload of fish at Cape Town docks, South Africa, engineers are enthusiastic. They're thinking about using it too, as a refrigerant in mine air-conditioning and in parlor cars on trains.



Treat in the Drum if You Can

Simple device mixes solution and feeds directly to drum of individual boiler in plant where pretreatment is unnecessary

By S H Coleman

CONDITIONING by feeding corrective chemical compounds directly to the boiler is often the most satisfactory and economical way to prevent scale, corrosion, and caustic embrittlement. In the usual high-pressure installation, this method of treatment is used for final conditioning after the feedwater has been treated in softeners or evaporators. Occasionally, however, raw water is relatively free of undesired impurities and pre-treatment is therefore uneconomical. In such cases, all conditioning may be done within the boiler, even at high pressures and ratings.

Compounds for internal treatment are dissolved in water and introduced ahead of the boiler-feed pumps or pumped directly to the boiler drum. Correct conditions can be maintained by varying proportions of chemicals in solution or by varying rate of feed of a standard solution. In either case, operation is guided by frequent analyses of boiler and feedwater.

Theoretically, necessary chemicals should be fed at a rate proportional to quantity of makeup entering the feed system. Commercial proportioning devices are available to perform this function and are usually applied where the treatment can be fed into low-pressure tanks or heaters on the suction side of the boiler-feed pump. Where the solution must be pumped directly to the boiler drum, to avoid complications resulting from precipitation of solids in feed piping and heaters, pump speed is regulated in proportion to quantity of makeup and solution is apportioned among the individual boilers, according to steaming rates. In either system, the water condition in an individual boiler may get out of line through faulty functioning of control devices, leaking blowdown valves, mistakes in blowdown procedure, or other cause.

Separate Tank

A separate solution tank and pump for each boiler permits adjusting abnormal water conditions in individual boilers. Such an arrangement can be used as a complete treating system for large boilers having a load that can be predicted with reasonable accuracy, and whose feed contains a fairly constant percentage of exceptionally pure raw water.

The sketch shows arrangement for complete conditioning in individual boilers of a large 400-lb industrial power plant. Solution is fed at a constant hourly rate and quantities of chemical (mono-sodium phosphate, phosphoric acid, and sodium sulphate) dissolved are regulated by daily boiler water analyses and anticipated demand. As the hourly steaming rate is reasonably constant, there is no need for automatic speed control of the chemical pump. A manual adjustment is provided, however, to care for any unusual conditions and to synchronize the pump rate with the hourly marking on the depth gage of the tank.

A heavy canvas lining keeps the upper part of the tank wet at all times. This prevents drying and shrinking of wooden staves as the solution is pumped down. Each fresh batch of chemicals and water is thoroughly mixed by a portable motor-driven agitator. Solid material is kept out of the suction line by a fine-mesh strainer. The pump, all check valves, shutoff valves, and piping are of stainless steel.

In the original installation the chemicals were piped directly into the feedwater line. Precipitated impurities soon blocked the section of feed pipe within the boiler drum. The piping was then rearranged so that the treating solution entered the drum directly. No drum corrosion from phosphoric acid has been experienced.

It has been possible to maintain, without serious variations, an average total alkalinity of 500 ppm, a phosphate radical concentration of 60-100 ppm and a sulphate total-alkalinity ratio of 3 to 1, as recommended for an operating pressure of 400 lb by the A S M E Boiler Code Committee. By adjusting the relative quantities of mono-sodium phosphate and phosphoric acid, the phosphate radical concentration is kept up and the alkalinity held down without resort to excessive blowdown (the raw water contains alkaline sodium compounds). Boiler operation with these average concentrations has proved satisfactory.

RELIABLE WATCHMEN

Don't Just Grow

By T L Lawson MAINTENANCE FOREMAN, RADIO CONDENSER CO.

Watchmen's reports serve as perpetual lessons in routine inspection, provided they are closely followed up

DISASTER STRIKES a plant, and sometime later someone thinks that it might have been a good idea if the watchmen had been trained for emergency action. Frequently watchmen are men unable to do other work, and the easy regular duties of watching seems their prerogative.

Appointment of a supervisor to carry on a continued routine of instruction is a foremost requisite for training watchmen. An employee of the general maintenance department will usually qualify for the instructor's job; if not, the master mechanic or plant engineer should be drafted for this important detail. A possible instruction program for an average size industrial plant with sprinkler system but no night fire brigade might take the following form:

Instruction Program

1. Fire drills every three months. At the same time all watchmen are shown street alarm boxes, what phones to use and how to use them to get aid.

2. Oral examinations on the watchman's special instruction book.

3. Questions on sprinkler valves to take place at sprinkler-valve control rooms. Cause sprinkler alarm to ring so that watchmen will know sound and be able to locate system that is in operation. Allow watchmen to close and open sprinkler-control valves. Stress the all important fact that when the alarm rings, no valves are to be shut off! Investigation for fire or sprinkler-system damage comes first—then appropriate action follows.

4. Questions and answers on dry-valve operation.

5. An easy tolerant atmosphere must exist and all questions, no matter how trivial, must be answered.

6. Have a sprinkler head piped to the outside of the building and melt it off with a small fire on a long stick to demonstrate sprinkler action. Show how a sprinkler head is renewed and special head wrench.

7. Show special hazardous locations such as spray room, oil process tanks, paint rooms, etc., with separate sprinkler controls or other fire protections.

8. Examine watchmen on knowledge of extinguisher and hose locations, pointing out the need for clear aisles to such apparatus.

9. Build a few small fires in the yard well away from inflammable material or buildings. Caution watchmen on proper selection, carrying and use of extinguisher. Demonstrate proper method of positioning the hose, lifting off hook, carrying and completely upsetting to use.

10. Proper instruction on safeguarding property against thieves should include means of contacting police without exposing watchmen to violence.

Extinguishers should be painted different colors to designate either foam or acid, and mounted on especially painted red and white backgrounds. All sprinkler-control valves and adjacent piping should be painted bright red and kept clean, to advertise their importance. Make available emergency oil or electric lanterns in a special locker with other emergency tools and sprinkler parts. Use special instruction books and report sheets for reporting of conditions.

If your watchmen are incapable of handling emergency duties, then supplement their facilities with centrally supervised rate of temperature rise or sprinkler systems. Then when the ever-present menace of fire comes the mechanical aids to your watchmen will function and help them to do the job you want them to do.

Watchman's Report

DATE..... NAME..... TIME.....

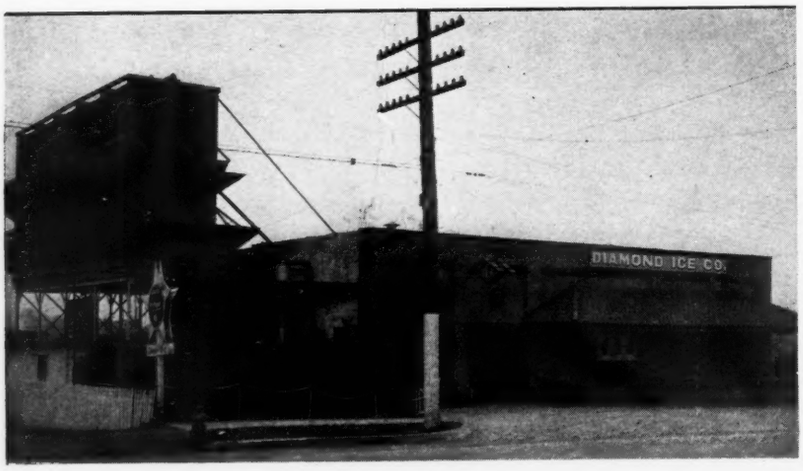
1. Are all windows locked?.....
2. Are all doors locked?.....
3. Is material stored in main aisleways?.....
4. Are all watchman's emergency and pilot lights clean and in good order?.....
5. Are all sprinkler valves open and sealed?.....
   - Building No. 1.....
   - Building No. 2.....
   - Building No. 3.....
   - Building No. 3 extension dry system.....
6. Is pressure above 10 lbs. on dry system?.....
7. Are there any leaks in toilets or water valves?.....
8. Are there any leaks in air lines or valves?.....
9. Are there any leaks in steam lines or valves?.....
10. Are there any roof leaks?.....
11. Are all hoses, extinguishers and buckets clear for instant use?.....
12. Did you have trouble with:
    - Doors..... Windows.....
    - Gun..... Boilers.....
    - Valves..... Persons.....
13. Did you have any kind of trouble?.....
14. Do you read and understand your General Orders Book?.....
15. Temperature when boiler No. 2 was started.....
16. Time Boiler No. 2 was started.....
17. Time Fans were started 12 lbs. pressure.....
18. Time Plater was started.....
19. Are all valves on heating system set for proper operation?.....
20. What have you to report?.....

Use reverse side if necessary for more detailed report.

WATCHMEN: Continue to report any condition until it is repaired.

I have myself made these inspections and sign this report as correct:

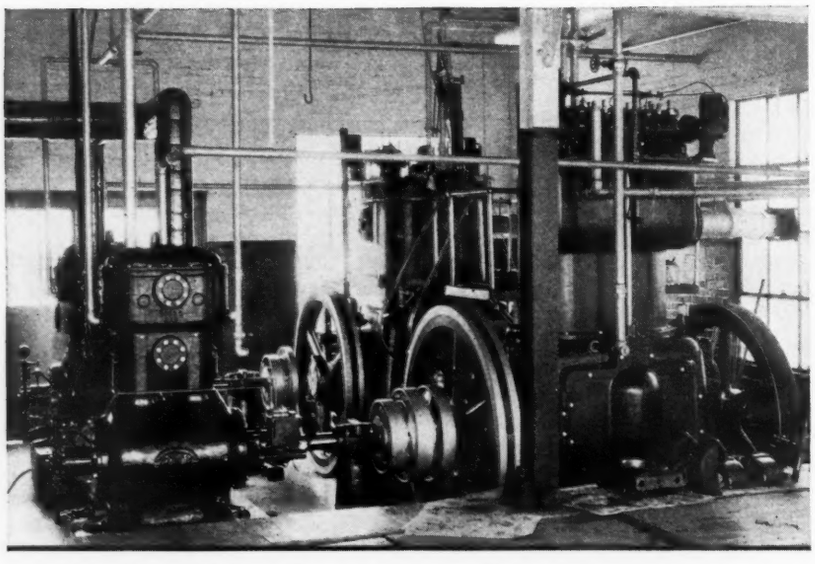
Watchman.....



Gas Makes Ice in Dallas

Diamond Ice Co makes its ice for less than 50 cents a ton by using gas-engine-driven refrigerating compressors

By
Orville Adams



Two 80-hp Bruce-MacBeth gas engines, direct-connected to Frick refrigerating compressors, at Diamond Ice Co Power is provided by a small generator between engines, V-belted to the flywheel as shown at right

BASED ON 60 KWHR per ton of ice manufactured, purchased power in Dallas would cost $0.62 to $0.65 per ton, approximately 20% of the gross wholesale price received by manufacturers, who all market on a quota basis through a single distributor. Salaries, upkeep, repair, and general overhead must also be deducted from the $3.50 per ton paid the manufacturer.

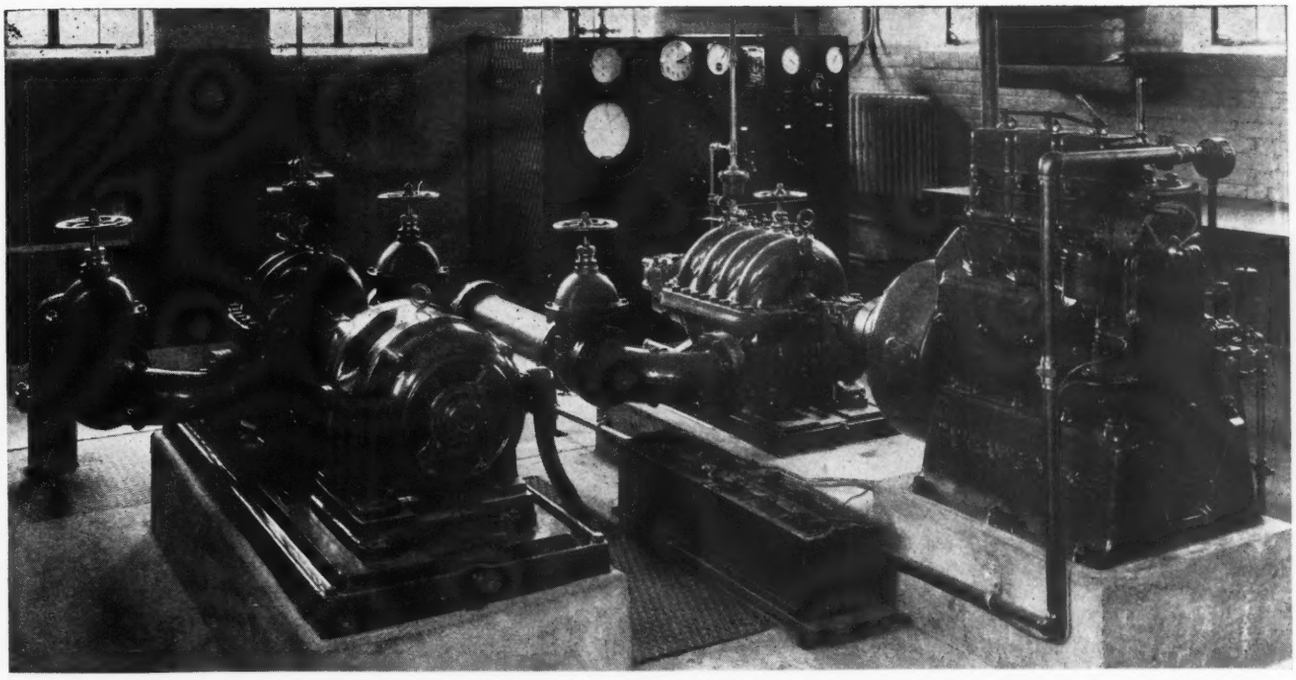
In contrast, the gas-engine-driven, 42-ton plant of Diamond Ice Co shows a total operating cost of $0.42 per ton, including fuel and oil, water, labor, waste, etc, because of low local natural gas rates. Here are costs for May, 1937:

Gas, 756,200 cu ft @ 19¢ per 1,000	$193.72
Water (purchased from the city).	140.00
Lubricating oil and waste.....	16.90
Labor (two operators).....	212.00
Telephone & SC tax on payroll...	14.24
Total	$576.86

Total production, 30 days @ 42 tons per day	1260 tons
Revenue @ $3.50 per ton.....	$4410.00
Consumption of gas per ton.....	664 cu ft
Gas cost per ton @ 19¢ per 1000 cu ft	$0.12636
Lubricating oil and waste.....	0.00751
Water	0.11111
Labor	0.16000
Phone, misc, tax, etc.....	0.01300
Cost per ton.....	$0.41798

The gas engines do not increase labor cost over electric operation, and lubricating-oil cost (which includes lubricants for the rest of the plant also) is satisfactory. This leaves the manufacturer a little over $3 per ton profit on 7500 tons for the six operating months, an annual profit of $22,500, with a saving of $3,500 over the cost of purchased power.

Efficient plant design is important in obtaining these low costs. Engines are direct-connected to ammonia compressors, with auxiliary power provided by a generator between them which can be powered by either engine through V-belts on the engine flywheels. Compressors are close to the tanks, and refrigerating lines are large and short, reducing line losses to a minimum and giving maximum effective space. A small motor-driven compressor holds vault temperature during the winter when the plant is not in operation, and a large cooling tower on the roof serves both engines and compressors. In operation, the plant runs at full capacity and 100% load factor, which speaks well for the reliability of the engines, now in their sixth season.



Diesel by Day, Motor by Night

By Paul Howard WHITMAN & HOWARD, CONSULTING ENGINEERS, BOSTON, MASS.

As told to Francis A Westbrook

TOWNSEND, MASS., has in its waterworks an unusual pumping combination, utilizing a diesel-driven pump during the day (when an attendant is on duty anyway) and an automatically controlled motor-driven pump at night. This makes it possible not to exceed minimum guaranteed electrical energy charges while still taking advantage of diesel economy.

Average operating conditions, day or night, are: 300 gpm against 205-ft discharge head with 10-ft suction lift, making a total dynamic head of 215 ft. The diesel is a 30-hp, 1200-rpm, 3-cyl, 4½x6-in., 4-cycle, solid-injection, Fairbanks - Morse, direct - connected through a Falk flexible coupling to a 4-stage Gould centrifugal pump. Cooling water is drawn from the high-pressure side of the pump and returned to the suction side. Lubrication is force feed; starting through an automotive-type storage battery. The exhaust line leads to a 3-in. Maxim silencer in an alcove, its outer end projecting through the building wall to atmosphere. Fuel oil is stored in an outside, underground, 1000-gal. tank, from which it is pumped electrically to a day tank beneath the engine. A hand transfer pump is provided in case of power failure.

The motor is a 25-hp, Fairbanks-Morse, 1800-rpm, constant-speed, induction type, direct-connected through a Falk flexible coupling to a 2-stage Gould centrifugal pump. Two Nash vacuum pumps are provided, one electrical, the other driven by a 3-hp, 1800-rpm, Lawson gasoline engine. They remove air from piping, water pumps and the combined air tank and sand catcher in the alcove.

Automatic Control

The electrically driven vacuum pump is automatically controlled by two float switches in the air tank, one starting the pump at ½-tank and shutting it down at full tank, the other keeping two emergency circuits closed until the tank is only a third full. One protects the motor-driven centrifugal pump by shutting it down if it is running when the electrically-driven vacuum pump fails to start at ½-tank. The other, operated by the second float, provides the same service for the diesel-driven pump if running, by closing a solenoid valve in the fuel line. When this happens, the bypass valve connecting gas-engine-driven vacuum pump and air tank must be opened, so the gas engine and diesel can be started up. Thus water may be pumped under all conditions short of station wreckage.

There is also a transfer switch in the diesel-starting circuit which makes it impossible to run both the diesel- and motor-driven pumps simultaneously, avoiding any tendency of the operator, in case of extraordinary demand, to overpump and ruin wells.

Water level in the 500,000-gal. standpipe controls the motor-driven pump through the night, except between 5 and 11 PM, when a time switch normally cuts out the pump, to avoid peak-load period demand charges. In case of fire or other abnormal demand, however, which lowers the reservoir to half full, the time switch is cut out, permitting the motor-driven pump to operate until water level is raised to two-thirds full. During the rest of the night, the water-level switch in the standpipe starts the motor-driven pump when water level drops 5 ft below full, and cuts it out again when the standpipe is full.

During 1936 and 1937, the diesel-driven pump has averaged 4 hr per day operation, cost of repairs totalling only $18 last year. 84 gal. of fuel are required per million gallons of water pumped, and 6 qt of lubricating oil per 100 hr of operation. Lubricating oil costs $0.60 per gal., fuel $0.075, giving an average total of $6.64 per million gallons pumped.

AIME and ASME Discuss
Industrial Coal-Users' Problems

First joint meeting considers coal selection from both buyers' and producers' points of view

MAKING COAL selection easier for the engineers and owners of small industrial plants is the common goal of the coal industry, combustion engineers, and equipment manufacturers, as expressed at the first joint meeting of the Fuels Division, American Society of Mechanical Engineers and the Coal Division, American Institute of Mining & Metallurgical Engineers, held at Pittsburgh, Oct 27–29. Papers on the coal-burning characteristics of different types of firing equipment and on properties of coal and its treatment during production were presented, giving the viewpoints of both users and producers.

Coal for Chain Grates

Almost any solid fuel of suitable size can be burned on chain- or traveling-grate stokers, according to Gosta Anbro, superintendent of power, Colgate-Palmolive-Peet Co. But for efficient operation, strongly coking coals, particularly those from the eastern slope of the Alleghenies, must be ruled out. In addition to the usual limitation on high ash content, coal for chain- or travelling-grate stokers should not have too low an ash content, say not below 6% for bituminous coals. Quantity and character of ash seem closely related to the protection of grate surfaces. Ash should have a high fusion point and a minimum tendency to flux with refractories. Uniform sizing and freedom from dust are also important. Dust is particularly objectionable in plants with slagging troubles, and in many cases it may pay to use a carefully sized or prepared coal, even at a price premium.

Only one out of every seven coals tested in an exhaustive selection program carried out by a Middle West industrial plant proved satisfactory, according to an experience cited by J E Tobey, manager, Fuel Engineering Division, Appalachian Coals, Inc. Coals from 130 mines were analyzed and given burning tests under service conditions and, at the end of three

G B Gould
President of Fuel Engineering Co of New York

years, it was found that the output of only 18 mines was suitable for use in this plant. It is significant that none of the 18 were on the original "approved" list of 60 mines, a list which had been used as a buying guide for many years. Further study and comparison of quality, price and general availability reduced the 18 mines to 6, and longer burning tests on the remaining 6 led to the selection of a single mine whose output has been successfully used for several years. Factors contributing to the problem of coal selection in this plant were various mechanical difficulties, necessitating the removal of heating surface from some of the boilers for better gas flow, changing baffling arrangements, and improving air distribution and control.

Contrary to the rather widely held impression that any kind of coal is suitable for pulverized firing, as much difference can be obtained between the use of an unsuitable and a suitable coal with pulverized firing as with the average stoker, according to a paper presented by B E Tate, chief engineer, National Cash Register Co. First consideration must be given to use value, that is, the effect, not on the cost of 1000 lb of steam, but on the entire plant cost. This is a highly individual item depending entirely on plant conditions, consequently no formula or general rule can cover it. Heat value, of course, can be measured and translated into dollars and cents. Grindability is a factor peculiar to the pulverized-coal plant, a factor that effects costs directly; pulverizer power consumption depends on it, and wear of pulverizer parts is governed by it.

Volatiles Important

Volatile content affects ignition and combustion and therefore furnace design. In general, high-volatile coals are more adaptable than low-volatile coals which often require special furnace conditions for satisfactory combustion. Moisture reduces efficiency, interferes with ignition and combustion, and seriously curtails proper operation of coal-handling and pulverizing equipment. Proper plant design, including drying before pulverizing or use of preheated primary air, will reduce moisture difficulties. Ash fusion temperature is a fairly sharply defined characteristic for pulverized-coal plants and will depend largely on whether a dry-bottom or slag-tap furnace is installed. High ash content is objectionable because of the expense involved in removal, because of possible air pollution and the need for dust collectors, because it lowers heat absorption by coating boiler surfaces, and finally because it retards combustion and increases carbon loss. An increase in pulverizer capacity or finer pulverization may be expected to result from use of coal in small sizes, but dust, moisture and handling problems are against it. Coal for pulverizers must be free of foreign material if costly outages and repairs are to be avoided. The nature of the ash formed is important in pulverized unit operation, since light, balloon-like

particles will increase fly-ash emission.

It was shown that the index of grindability is not always a reliable measure of the wear likely to occur on pulverizer parts, since the presence of pyritic sulphur or iron in the ash may cause trouble even with coals of high grindability. In connection with drying coals of high moisture content by use of primary air, it was pointed out that the temperature of the primary air was immaterial as long as the outlet temperature stayed in the neighborhood of 160–180 F.

Screening and sizing, dust removal and cleaning, all coming under the general term "preparation", may lower ash content, increase the heat value, and make a more uniform coal that is often better for steam generation than an untreated coal. All these advantages cost money, and, according to H F Hebley, advisory engineer, Commercial Testing & Engineering Co, who presented a paper on Economics of Preparing Coal for Steam Generation, the problem is to determine how far to carry this preparation, to find out how much added efficiency the coal users want and are willing to pay for.

"Fuel Savers" Tested

For more than 100 years, coal users have tried to improve the burning of coal by the addition of small quantities of chemicals, frequently sold under trade names and referred to as "fuel savers." A report of an extensive and thorough investigation of the value of such substances was presented to the meeting by P Nicholls, supervising fuel engineer, U. S. Bureau of Mines, Pittsburgh Experiment Station. Twenty-five chemicals were tested in special furnaces whose conditions could be carefully controlled and various types of firing and rates of combustion were employed. Special attention was given to possible effects on caking, on reactivity, on ignitibility, on smoke and soot formation, on ash and clinkering, and on sulphur. All chemicals tried produced an effect on the burning coal, but no particular gains were noted except in the case of caking, an effect not previously mentioned in any patents or literature on this subject. A small but definite retarding of caking was found to occur, increasing with the amount of chemical used. Sodium carbonate proved to be most effective. But it was also shown that water alone is as good as any chemical tried, which tends to substantiate the experience of chain-grate operators who have found that tempering with water is beneficial for combustion. The general conclusion reached by Mr. Nicholls was expressed as follows: "Not every type of coal, nor every possible set of conditions was included in these tests; those used were broad enough so that findings justify purchasers of materials for improving the combustion of coal in expecting more proofs of the claims made for them than have been furnished in the past."

Segregation of coal may cause spotty fires with blowholes, upset air distribution, cause excessive coking and clinkering in some cases, and so reduce capacity and efficiency. It is a problem both for user and producer, since segregation may occur at any point between mine and firing equipment. According to D R Mitchell, assistant professor of mining & metallurgical engineering, University of Illinois, segregation is of two kinds: size segregation in which large and small pieces tend to separate, and density segregation, in which separation by density or specific gravity takes place. In the plant, segregation can be avoided, or reduced, by loading conveyors in the direction of travel instead of at right angles, by using conveyors in which little or no movement occurs within the coal mass, by careful filling of bins or bunkers with properly designed chutes and distributors, and by use of conical or curved spreader chutes at the stoker hoppers. It was further pointed out that producers are endeavoring to prevent segregation in coals as delivered to the consumer. Interest in the subject and its practical importance were demonstrated by an active discussion in which troubles from segregation and methods of avoiding it were both considered.

Variations Predicted

Coal buying is complicated by the fact that coal is a non-uniform product; coals from the same mine and seam may vary widely as to characteristics. The development of methods and data for the prediction of variation in coal characteristics, was the subject of a comprehensive paper by G B Gould, president, Fuel Engineering Co. It was found by the statistical study of hundreds of coal tests, and by correlating other statistics along similar lines, that the variations in any given property of coal tend to group themselves around the average according to the normal frequency curve with a slight skew. If the probable error for a property of a given coal is known or can be determined, the variations from the average that might be expected can be predicted with some accuracy. This has several interesting and important applications. Its gradual absorption and use by coal buyers and coal salesmen cannot help but impress on both the frequently forgotten fact that any coal shipment may vary from the average analysis on which it was sold, and that such a variation does not mean that deceit has been practiced by the shipper. Use of this principle will enable a buyer to estimate with some exactness the probable departure from the average analysis of a series of shipments of coal. Equally, it will enable the chances of rejection to be calculated in the case where coal is bought on a minimum requirement basis, and will of course serve to make the setting of such minimum requirements a more intelligent process. And further, according to Mr. Gould, sampling accuracy can be shown to depend on the number of increments making up the gross sample rather than on the weight of the gross sample as was formerly held. This means that smaller gross samples can be taken with a great saving in preparation and reduction but no loss in accuracy.

Research Needed

Research and education are the fundamental answers to the problems of fuel selection and use advanced by R A Sherman, fuel engineer, Battelle Memorial Institute. The user of coal must learn to know the requirements of his equipment, not just in a general way, but exactly and completely. Test methods are needed to bring out some standard measure of coal characteristics for which no generally accepted measure now exists. Caking or coking characteristics are examples of highly important properties of coal, recognized in a qualitative way, but for which no accepted method of measurement is available. Even more important is the need for knowledge of the relation between measured coal characteristics as shown by test and analysis, and actual burning qualities as displayed on commercial grates. Progress is being made on all these fronts and should continue at an accelerated rate now that the efforts of large coal users, equipment manufacturers, universities and the government are being supplemented by the joint action of coal producers, who are at last taking their proper place in the picture.

A paper on fundamentals in Dustproofing Coal was presented by H R Fife, industrial fellow, Mellon Institute, and P W Edeburn, chemist and preparation manager, Butler Consolidated Coal Co. B M Guthrie, chief engineer, Stoker Division, Fairbanks, Morse & Co., described the development of the domestic stoker.

Interest displayed in this first joint meeting led to the passing of a resolution for continuation of the idea and the appointment of a committee for promotion of joint activities.

A cavitated cast-steel wheel for Don Pedro Dam, later repaired by metal spray

Wearproof Overcoat

Sprayed stainless rejuvenates waterwheels, wear plates and shafts

By R E Kunkler

ENGRG DEPT, METALIZING CO OF AMERICA, INC, LOS ANGELES, CALIF.

AN EARLY APPLICATION of sprayed-metal coatings was the repairing of a cavitated turbine runner at the Cohoes (NY) hydro station of N Y Light & Power Corp. This Francis wheel, operating under 96-ft head, was repaired in place in October, 1932. Various metals were tried with the Mogul metallizing gun, with the result that stainless steel proved to be most practical and economical. Since that time a number of similar runners have been rebuilt.

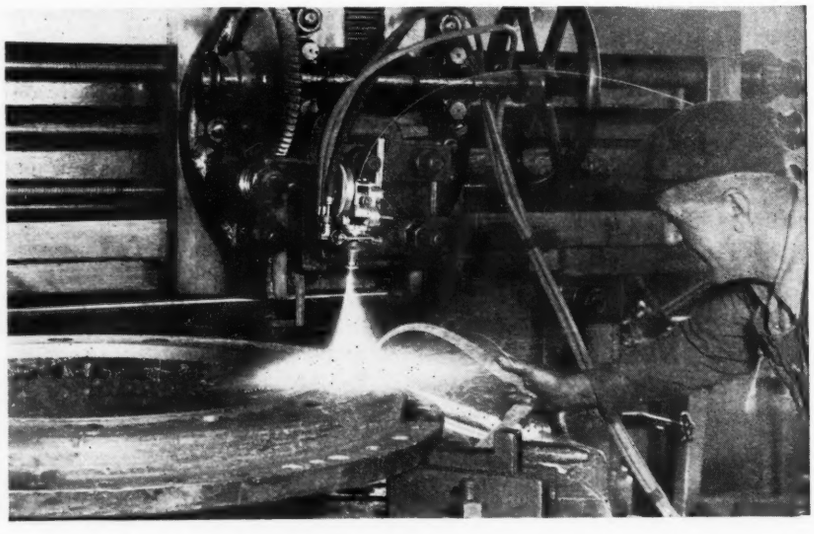
Early last year, L H Parker, electrical engineer at Don Pedro Dam, Turlock (Calif) Irrigation District, and I supervised repair of the cast-steel wheel illustrated. The work proved so successful that a number of wheels have since been repaired, including bronze wheels in which there was cavitation to a depth of $\frac{3}{4}$ in. over a surface area of 8 in. Deeper cavitated areas require drilling and insertion of small pins to which the sprayed coating can cling, but the normal area can be filled after sandblasting to give a clean, rough surface. Four or five pounds of metal may be deposited in an area by holding the gun in place.

Propeller-type wheels may be built up as well as the bucket type. For example, a propeller turbine for the Bureau of Reclamation power plant at Yuma, Ariz., was sprayed with stainless steel along the blade tips two years ago. A recent inspection showed that sand and silt in the Colorado River water had only polished the coating, so the same process has now been adopted for wicket gates and vanes, as well as spraying over 2,000 sq ft of surface with zinc.

Turlock also made use of sprayed stainless steel in building up an 18-in. turbine shaft to run in a lignum-vitae bearing and for building up stems on wicket gates. Valve stems and pump rods have been built up to gain noncorrosive and wear-resisting surfaces.

One of the unusual applications is on wooden insulator pins for San Diego Consolidated Gas & Electric Co. Formerly, sparks ignited the pins during heavy fogs, causing them to smoulder, with consequent damage to the line. With the pins zinc coated, sparks are dissipated.

Building up wicket-gate wearplates with stainless steel



FLUID HIGHWAYS I

(Fluid Highways—II will appear in Mid-December)

PIPING ELEMENTS

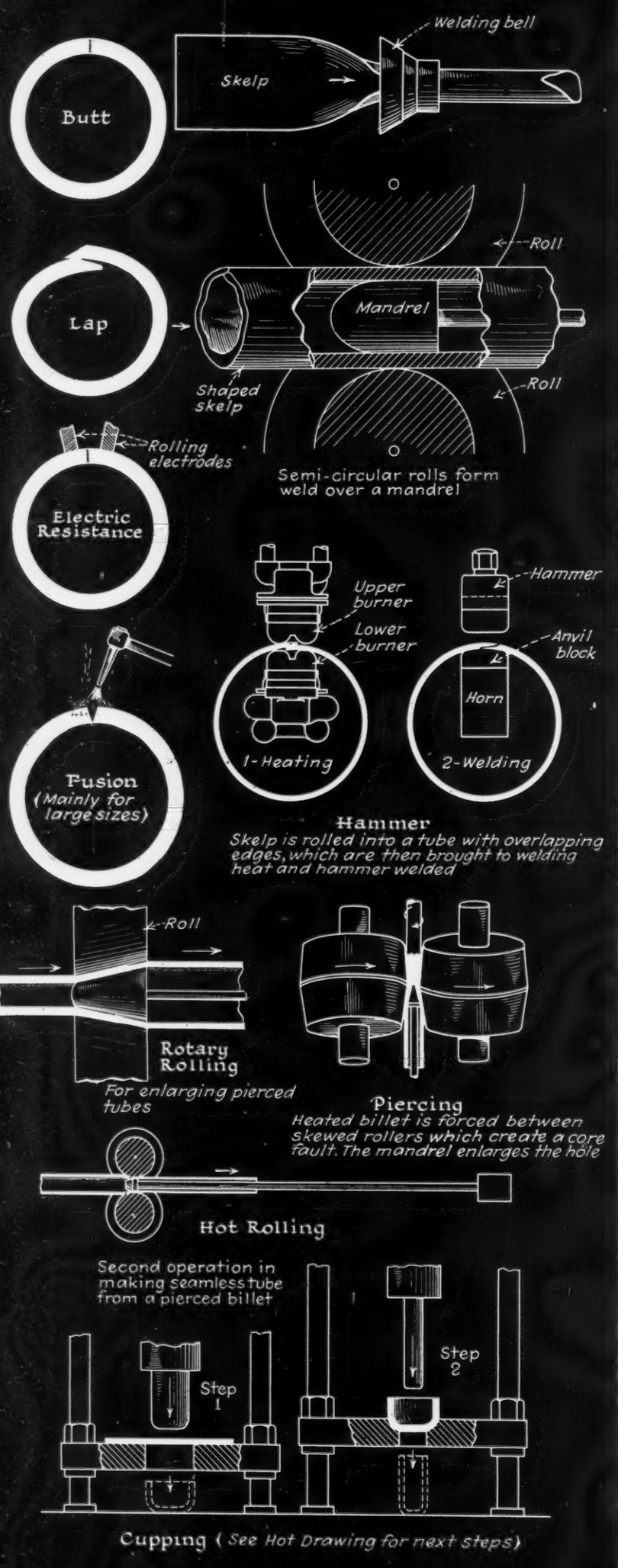
CNOSSIANS of ancient Crete had drains, running water, heating equipment and inside bathrooms four thousand years ago, a knowledge of piping that the Greeks and Romans who followed them forgot, or didn't understand. A bare 300 years ago, the French began again to use wood-stave and cast-iron pipe, and our modern knowledge of piping was born. But only within the last half century has it grown to any stature.

Pipe basically is a simple thing, for it is simply an enclosure for transmitting fluids from one place to another. But make those fluids very hot, put them under high pressure, or make them corrosive or erosive, and the problem becomes infinitely more difficult. It demands special materials and treatments that tax engineering ingenuity and multiply costs. And maintenance expense varies inversely with ingenuity and first cost, so we find the capable engineer spending much time, and from 10% of the total cost of a central station to 30 to 50% of the cost of some industrial plants, on his piping installation.

To help him make proper selections for simple installations and to understand the recommendations of piping experts for more complicated ones, the editors of *Power* three years ago compiled their first special section on piping. But, since that time, welding has advanced markedly, new materials and methods have been developed, new problems have arisen, so it is advisable to bring this basic material up to date and to add to it the associated data on valves and fittings.

That has been done in this fifteenth of *Power's* special sections. Because of its length, it has been divided into two parts. The first, appearing in this number, deals with *elements*; the second, in Mid-December, deals with *systems*. This first section pictures types of pipe, valves, traps and fittings. Materials, specifications and services are indicated. In Mid-December, we shall show the variations essential to meet operating conditions—the types of joints, the kinds of pipe, the ways of connecting traps, strainers, separators, and cleaners, for various services, pressures and temperatures.

Combined, these sections provide a handy manual for the power engineer in his development and handling of piping systems, a solid technical foundation for trouble-free fluid highways.



PIPE

PIPE is made from many materials and in many ways, to suit wide variations in corrosive and erosive properties of fluids handled and to meet problems introduced by high pressures and temperatures. Furthermore, price is vitally important; no one wants to buy a better piping system than the cheapest that will do the job right. Cost of eventual replacement, involving lost or delayed production, make worth while the effort necessary for proper initial selection of pipe material and joints.

Much ingenuity has been devoted to developing pipe to meet specific needs. Over a period of years, new kinds of pipe have replaced older "standard" ones—for example, lead pipe for domestic water systems is now practically obsolete. Often the answer has been found in a material new to the user, a new jointing method, or a new method of fabricating a known material at a lower price. Occasionally a special lining or coating has solved the user's problem—as in tinned-copper tube or galvanized pipe.

Principal piping materials and methods of fabrication are shown in Table I, relative costs in Table II. Steel is by far the most common pipe material, particularly the mild-carbon steel commercially known as "black iron" and its "galvanized" counterpart (which is just the same pipe plus a zinc coating).

Kinds of Pipe

Seamless-Steel Pipe—For steam at high temperature and pressure, and for high-pressure water services, seamless-steel piping (or tubing, as it is generally called) is almost universally used because of the high tensile strength of the finished material, uniform strength in all directions, and because no weld interferes with forging laps for joints. Steam temperatures have topped limits for which carbon steel is entirely satisfactory, and increased use of alloys has resulted, principally carbon-molybdenum and chrome-nickel steels. Power-plant piping is covered in various ASTM, ASME and ASA specifications and standards, both as to material specifications and dimensions. These are listed in Table III. The stainless steels

and irons, principally used in process piping in food and chemical plants, breweries and distilleries, are made by different manufacturers in varying analyses depending upon temperatures or corrosive conditions encountered in service.

Seamless tubing is fabricated from a cast ingot, hot-rolled into a bloom. The bloom passes between heavy tapered rollers set askew which work the metal over a piercing point to make a hollow billet in the form of a rough, thick-walled tube. Tubing is then either "hot-finished" by rolls over a mandrel to final size or "cold-drawn" through dies on a draw bench. Usual lengths range up to 45 ft, sizes from ⅛-in. pipe size up to 28 in. outside diameter. Sizes 12 in. and below are "iron pipe size" (nominal size is approximate inside diameter); above 12 in., sizes are outside diameter. Several wall thicknesses are available. In large sizes and heavy walls, length is limited by the size of ingot that can be handled.

Carbon-steel, and practically all alloy-steel, pipe can be joined by welding, now accepted standard practice for steam at 1400 lb and 900 F. Welding fittings are available. Van Stone and other ring-flanged joints are also used in all but very small sizes, which are commonly threaded.

Forged-steel pipe is used occasionally for exceptionally difficult services, particularly under terrific hydraulic pressures. It is made from a forged blank, machined to size. Flanges and outlets are machined from solid.

Welded-Steel Pipe — Designed for the same services as seamless steel tubing. Pipe is formed by rolling beveled plate (called "skelp") to circular section and resistance-welding a longitudinal seam. Has high joint efficiency. Its applications are increasing. Large sizes or special pipe are also made by hammer or fusion welding, hammer welding (90-95% weld efficiency) being more expensive than the other two methods.

Butt-Welded Steel Pipe—Cheapest, and satisfactory for general-purpose use in all moderate-pressure service is butt-welded pipe, made in sizes up to 3 in. by drawing skelp through a die at welding temperature, then drawing to size and straightening. It is furnished in ⅛ to 3 in. pipe size in three standard weights. Weld efficiency is considered as 76% of the strength of the parent metal. Threaded joints with malleable or gray-iron fittings or companion flanges with cast-iron fittings are usual, so the pipe is furnished threaded unless specifically ordered otherwise.

Lap-Welded Steel Pipe—Similar to butt-welded, but with weld efficiency of 90%, lap-welded pipe is used for the same services, but is suitable for more severe conditions and larger sizes. Sizes are 1¼ to 30 in., and cost in the overlapping range is greater than that of butt-welded pipe. Lap-welded is fabricated from skelp with edges scarfed so that when they are overlapped, wall thickness will be uniform. Skelp is passed through pinch rolls, then through a bending die or around power bending rolls to form a rough unwelded tube, then heated to welding temperature and passed over a welding bell held firmly on a long bar between welding rolls. Chilled rolls true up the pipe and give accurate inside diameters, then sizing rolls true exterior diameters and cross rolls straighten the finished pipe. It is made in three weights, with ends plain, beveled for welding or threaded as desired. Joints are usually threaded in smaller sizes, so unless otherwise specified, small sizes are furnished threaded with a coupling at one end. Intermediate sizes have companion flanges, forged laps or are welded. Fittings are cast iron or cast steel for flanged construction and malleable or cast iron for threaded.

TABLE I—PIPE TYPES AND MATERIALS

Steel, carbon or alloy
- Seamless
- Mechanically Welded
  - Hammer, forge, lap, butt
- Fusion Welded
  - Torch, arc
- Resistance Welded
- Spiral Riveted
- Longitudinal Riveted

Wrought Iron
- Lap or Butt

Copper-Molybdenum Iron
- Butt or Electric

Cast Iron (Gray, Malleable, Chilled, Alloy)
- Pit or Centrifugally Cast

Mainly extruded and drawn
- *Copper*
- *Brass*
- *Aluminum*
- *Lead*
- *Block Tin*
- *Monel*
- *Nickel*

Mainly cast
- *Tile*
- *Concrete*
- *Wood-Stave*
- *Transite*
- *Fiber*
- *Plastic*
- *Hard Rubber*
- *Glass*

Flexible Pipe
- Rubber Tubing
- Rubber Hose
- Synthetic Rubber
- Fabric Hose
- Metallic Hose

Linings (usually in steel)
- Rubber
- Cement
- Glass

Finishes
- Galvanizing (zinc)
  - Steel or wrought iron
- Tinning
  - Copper tubing
- Nickel or Chromium Plate
  - Stanchions, lab. pipe
- Enamel
  - Special processes
- Wrapping
  - Insulation
  - Wire, hemp, jute

Finishes—Both butt-welded and lap-welded pipe can be zinc-coated ("galvanized"), either by hot dipping or by plating. There are also special coatings and wrappings, if desired.

Reamed and Drifted Pipe—Butt or lap-welded pipe can be furnished with the cut ends reamed to eliminate burrs and the inner wall smoothed and sized by forcing through a drift pin on a long mandrel. This is sometimes required for special jobs where exact diameter or smooth internal walls are important.

Riveted Spiral Pipe—For large sizes in low-pressure service, riveted spiral pipe, as the name implies, is fabricated from a strip of rolled plate twisted into a helix and riveted. Ends are fitted with flanges. Material may be low-carbon steel or ingot iron, and finishes may be as specified above.

Wrought-Iron Pipe — For general service, where certain corrosive conditions exist, butt-welded or lap-welded wrought-iron pipe has frequently been found to give longer service than steel. Genuine wrought iron is highly refined metallic iron with which is incorporated, without subsequent fusion, a minute and uniformly distributed quantity of slag. Sizes, methods of fabrication and joints are the same as for steel, except that no seamless wrought iron tubing is available. Cast or malleable fittings are used. Sizes 14 to 24 in. are made by lap, hammer, or fusion welding. The material can be welded, welding fittings are available, and it can be galvanized if desired. Though the material looks like steel, it is readily identified with the microscope or by manufacturer's markings.

Copper-Molybdenum Iron—Applications in general are similar to those for wrought iron, this material being an open-hearth iron containing 0.4% copper and 0.05% molybdenum or more. Butt-welded pipe ranges from ¼ to 1½ in., resistance-welded from 2 to 16 in., in two standard weights. Fin-

ish can be black or galvanized. Joints and fabrication are similar to those for steel.

Cast-Iron Pipe—For water service up to 250 lb pressure and 450 F, and for miscellaneous uses such as gas soil, vent or drain piping, cast-iron pipe is often justified by added service life. It is cast either in a pit mold or centrifugally by machine in sizes from 1 to 72 in. and several weights. Flanges and fittings are rated according to nominal pressures of 25, 125 and 250 lb. For hydraulic, non-shock service at ordinary room temperatures, pressure limits are greater than nominal. It is furnished with bell-and-spigot joints, integrally-cast flanges or plain ends. Integrally-cast flanges are customary for power plant service. Cast iron may be alloyed with other metals, such as silicon and nickel, to increase strength and resistance to corrosion or erosion.

Brass Pipe—For hot-water, process and small-size general-purpose piping, longer life may justify the increased cost of brass (some waters de-zincify it, however). It is usually fabricated by cupping and drawing, or by extrusion. These compositions are available in iron pipe size: commercial yellow brass (67% Cu—33% Zn), commercial red brass (85% Cu—15% Zn), and Muntz metal (60% Cu—40% Zn), from $\frac{1}{8}$ to 12 in. Some brasses contain a small percentage of lead to improve machining qualities. There are also several special alloys, such as Admiralty metal, aluminum brass and copper-nickel alloys. Fittings are threaded cast brass in small sizes and cast iron or brass for large lines. The pipe is customarily supplied with plain ends. The Government specifies red brass for hard service, yellow brass for ordinary service. Muntz metal is not good for water piping.

Copper Pipe and Tubing—Copper is available both in iron pipe sizes and as tubing with any wall thickness desired. There are four degrees of "hardness." It is fabricated by cupping and drawing. When hot-drawn or annealed it is very flexible, cold-drawn without anneal it is stiff. It is used in power plants for instrument and small piping and in buildings for water, refrigeration and air-conditioning lines. Because of its flexibility and resistance to corrosion, it has many process applications (paper mills, distilleries, breweries, also for underground gas lines). Because of the difficulty of cutting threads in copper, joints are usually made with compression or soldered fittings, the first requiring soft-drawn, the second hard-drawn, tubing. For certain corrosive services, copper is tinned inside or outside or both. Usual size range is $\frac{1}{4}$ to 12 in., either IPS (for pipe—rarely used because of cost) or OD (for tubing).

Stainless Steel—Although mentioned previously under "Steel Pipe," the many process applications of stainless steel justify somewhat greater detail. This is a general name for a series of alloys with varying contents of chromium and usually some nickel, carbon content determining whether they are "irons" or "steels." Composition varies with manufacturer and severity of corrosive service and temperature. Although some pipe has been made, stainless is usually furnished in tubing sizes, either seamless or butt-welded, the latter in sizes only up to 2 in. OD. There is also an "open-seam" pipe used for handrails, etc., and oval, rectangular, square and half-round shapes Round tubing comes in standard pipe sizes up to 2 in. and in a series of exact OD's from $\frac{1}{4}$ to over 4 in. "Shrouded" tubing is ordinary steel or iron pipe covered with light-gage stainless. Tubing comes in three weights and two hardnesses. Threaded fittings may be used, or on tubing, mechanical flanging, compression or soldered fittings. It can be welded.

Aluminum—Aluminum and alloy tubing find extensive process use. They are available in various wall thicknesses and sizes, commonest being $\frac{1}{8}$ to 8-in. IPS standard and extra-heavy. Joints can be threaded, Van Stoned or welded. Weight and strength are $\frac{1}{3}$ those of steel, but strength is adversely affected by temperature. Random lengths run 5 to 21 ft, specials may reach 55 ft. Flanges and fittings of the same material must be used.

Special—These include nickel, Monel hard rubber, Transite, fiber, asbestos, tile and highly chemical-resistant alloys. There are also laminated pipes, consisting of one material to resist erosion or corrosion, the other to give strength. Examples are rubber-lined, glass-lined and cement-lined steel or cast iron. They lick vital problems in specialized applications. Flexible pipe, fabric, rubber and synthetic-rubber hose, and flexible steel or other metallic piping have obvious uses where portability and flexibility are required.

Methods of Joining Pipe

(See also pages 788-789, Mid-December)

PIPE JOINTS are important in two ways: First, a considerable part of the cost of any piping system comes in making the parts of a joint in the shop and in the labor of field erection, the sum of these costs determining the cheapest joint. A second consideration, sometimes overlooked, is that pipe itself is nearly trouble-free (if proper material for the service has been selected) while joints are likely to be responsible for whatever maintenance money is required.

Threads—The most common is the American Standard Pipe Thread, cut on a taper of 1 in 16. The taper insures tightness when the threads are forced together. A sealing compound provides lubrication for making up the joint and rust protection to prevent seizure. The thread is 60 deg with a slight but definite flattening at crest and root.

Flanges—Flanges come three ways, cast integrally with the pipe, compan-

TABLE II—RELATIVE COSTS OF COMMON PIPING MATERIALS

(N. Y. quantity price on 2-in. p.s.—butt-welded steel pipe as A)

Butt-welded steel pipe, black, threaded and coupled	1.00
Lap-welded steel pipe, " " " "	1.19
Resistance-welded steel, " " " "	1.20
Seamless steel, black, plain	1.20
Butt-welded wrought iron, black, threaded and coupled	1.82
Lap-welded " " " " " "	1.96
Butt-welded copper-molybdenum iron, black, threaded and coupled	1.62
Lap-welded copper-molybdenum " " " " "	1.71
Stainless-steel pipe, IPS, plain ends	16.32
Stainless-steel tubing, plain ends, (2" O.D.) 14-gage	8.03
" " " " " " 16-gage	7.02
" " " " " " 18-gage	6.35
" " " " " " 20-gage	5.57
Yellow brass, IPS, plain ends	6.44
Red brass, IPS, " "	6.85
Copper pipe, IPS, " "	6.63
Copper water tube, heavy, plain ends	3.76
Copper " " medium, " "	3.36
Copper " " light, " "	2.88
Galvanizing 2-in. steel or wrought-iron pipe increases cost roughly	$5 per 100 ft.
Tinning (inside and outside) 2-in. IPS brass or copper increases cost roughly	$14 " " "
" " " " 2-in. copper tubing " " "	$10 " " "

Note: Cost on the warehouse floor should not be considered as the primary basis for selection. Transportation, fabrication and installation costs frequently are more than the cost of the pipe alone. Where corrosion is a factor, the least expensive pipe from the standpoint of initial cost may prove ultimately to be the most costly.

ion flanges internally threaded to be screwed in place on the end of a threaded pipe and ring or hub flanges separate from the pipe which bear upon laps forged integrally with the end of seamless tubing. The first class is practically restricted to cast-iron pipe. A modification of this idea, however, is found in forged flanges with stub ends for welding to the ends of seamless pipe. The second class, companion flanges, are much used in power-plant piping particularly for joining lap-welded steel pipe in sizes 4 in. and above. Field erection is simplified by cutting and threading to length as required and screwing on the flange to suit adjacent bolt holes. For low-pressure service, flanges are cast iron; steel is specified for higher-pressure steam service particularly when accompanied by higher temperature. Flanges are also available in bronze.

Several forms of flanged joint are suitable for high-pressure, high-temperature service, all of which (except welding) require forging a lap on the end of pipe or tubing. Various forms of joint require different kinds of laps with suitable gasket arrangements. Hub and ring flanges are invariably steel forgings or steel castings.

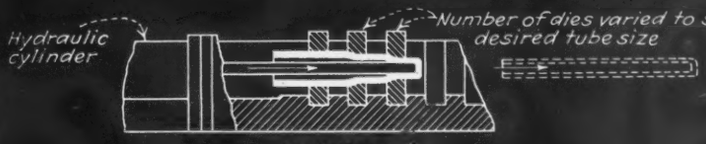
Welding—For 1400-lb steam at 900 F, the high cost of flanged joints and the difficulty of insuring tightness under severe operating conditions has led to the almost universal use of welding with flanged joints, if at all, at points likely to need taking down. This has been made possible by greatly improved welding technique, particularly in field welding, and by gradually increasing confidence in the ability of properly qualified welders to produce consistently reliable joints.

Fittings and valves with ends machined for welding are standard products. Increased use of pipe bends and of shop-fabricated headers and piping has reduced the number of fittings required, particularly in the large, heavy wall sizes. For small sizes, forged welding fittings for butt welding or socket welding are offered.

Compression Joints—For soft-drawn copper tubing, compression fittings are furnished in two styles, one requiring that the tubing be flared to engage the fitting and the second provided with a wedge element forced against the tubing in making up the joint.

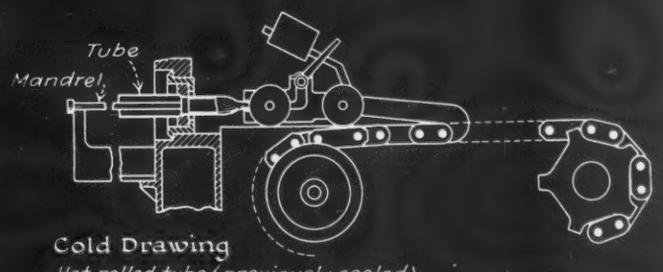
Soldered Fittings—Solder fittings of cast bronze, wrought copper and stainless steel are available with solder already applied to the fitting or for feeding wire solder. "Hard" and "soft" solders and brazing alloys suit different service conditions and, for stainless steel, some fittings use silver solder. The tin-lead soft solders are suitable up to 15-lb saturated

PIPE-MAKING PROCESSES - II



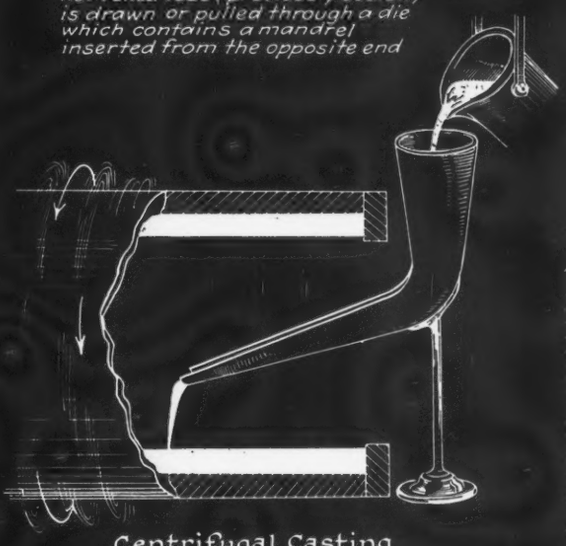
Hot Drawing

Heated formed cups are pushed by a hydraulic plunger through a series of dies which reduce diameter and elongate the tube



Cold Drawing

Hot-rolled tube (previously cooled) is drawn or pulled through a die which contains a mandrel inserted from the opposite end

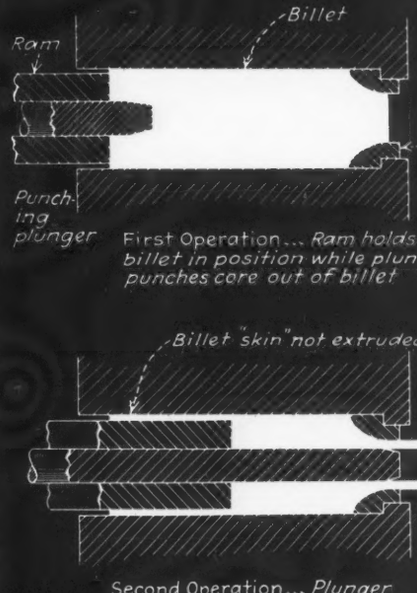


Centrifugal Casting

Only the principle is indicated here. Molten metal is poured into a rapidly rotating mold. Centrifugal force produces fine-grained, uniform castings

Sand Casting

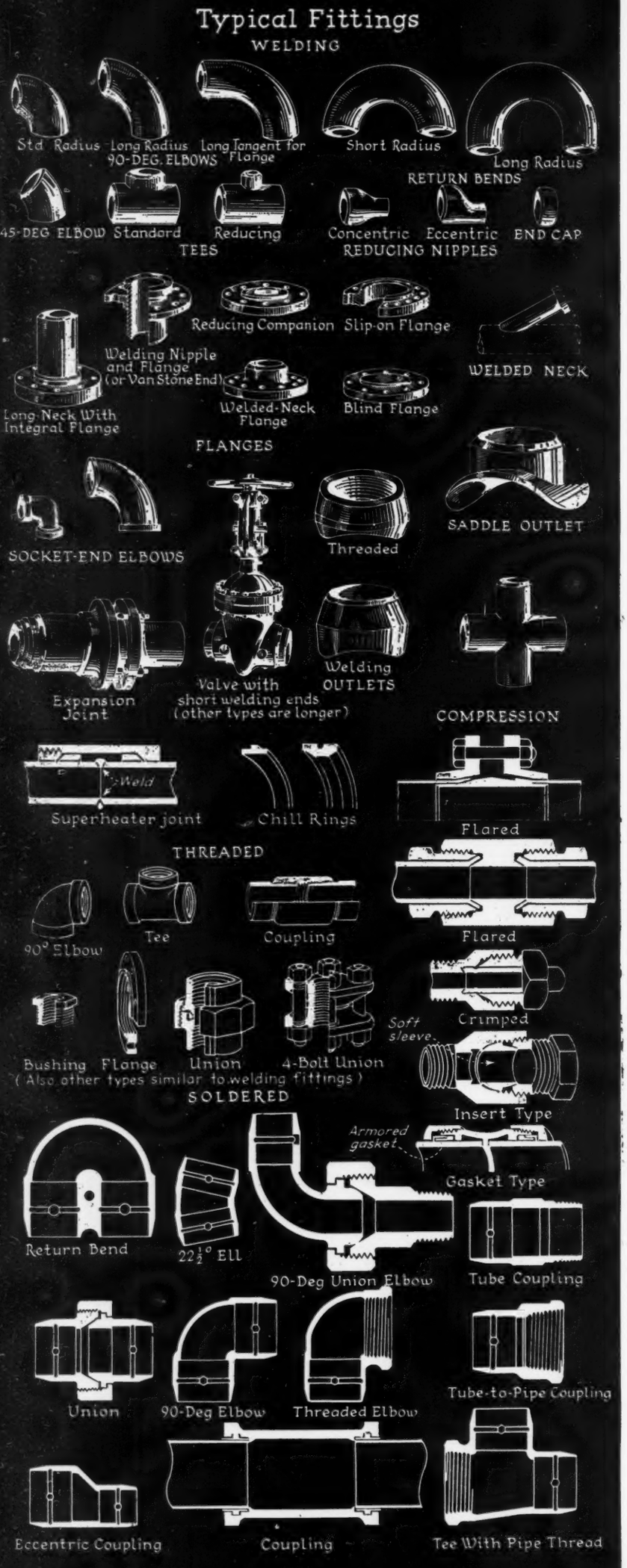
Only the principle is shown here. Molten metal is poured by conventional foundry methods



First Operation... *Ram holds a billet in position while plunger punches core out of billet*

Second Operation... *Plunger remains in billet as a mandrel while ram extrudes billet through die, forming a short, thick tube*

Extrusion



steam, and tin-antimony hard solders up to 65-lb saturated steam, although the principal value of the harder solder is to combat corrosion, not temperature. The brazing alloys handle steam up to 450 F and 150 lb.

Special—Certain specialized joint types have been developed for particular services, for example, ball-and-socket joints for low-pressure lines where flexibility is required, and quick-opening joints for temporary pump-discharge lines and the like.

Bolt and Nut Materials—While the usual flanged joint has low-carbon steel or wrought-iron bolts with square heads, for pressures over 160 lb and temperatures over 450 F they should be alloy steel, heat-treated, as in ASTM A 96-33. At high pressures and temperatures, it is customary to replace the usual headed bolt with a stud threaded for its full length, carrying hexagonal nuts at both ends. There are also special bolt materials for heavy duty or corrosives.

Nuts are mild steel produced according to the American Standard for Heavy Semi-Finished Nuts B-18b, and are of the cold-punched, hexagonal type. With alloy bolts, semi-finished, chamfered and trimmed nuts should be used. Material for such nuts must not include more than 0.45% phosphorus for high-pressure service. For temperatures above 750 F, hot-forged cold-trimmed nuts are being used.

Gaskets—For steam service most engineers now prefer thin gaskets of soft steel, copper-plated steel, or soft Monel. Thin metal gaskets require generally higher gasket pressure, resulting in a smaller gasket width for a given size pipe. Table V lists common gasket materials.

Expansion Bends, Loops and Joints—High pressure with accompanying high temperature has increased the problems introduced by expansion. Not only do higher temperatures induce greater expansion, but heavier-wall pipe required for the pressure and temperature is stiffer. Long-radius bends, corrugated or creased, are finding increased application not only to avoid the use of fittings insofar as possible but also to increase the flexibility of the entire system.

For moderate pressures (up to 400 lb) expansion joints and bends are in general use. These are of two types, slip and packless. The latter are of corrugated metal and many variations are available from the several manufeatures. Slip-type joints provide more movement than packless, but require more space for installation.

Pipe Supports—In power plants, piping is usually hung from beams or supported on brackets from building col-

umns. Piping run in tunnels is usually supported from below. Necessary types of support include anchors for preventing motion of the line in any direction, or permitting motion in a line or plane as required while restricting motion in all other directions. Hangers supported from beam clamps may be rigid, allowing motion in a horizontal plane only, or spring, allowing motion within limits in any direction while maintaining an approximately constant upward force on the pipe. A newly developed hanger includes a compensating lever mechanism which corrects for the expansion of the spring to apply constant force to the line throughout a specified range of travel. Adjustments provide for initial setting to suit field conditions.

Roller saddles provide greater allowable motion than do hangers in a direction parallel to the axis of the line but, even when adjustable, are usually limited to a rigid support in a vertical direction.

Sway bracing should be used to prevent lateral movement of small lines and to prevent vibration where pressure surges or water hammer are expected.

Insulation—The requirements for good insulating materials are numerous; no simple formula can be given either for choice of material or its application.

Pipe covering is applied principally for the purpose of reducing the flow of heat either from the pipe to the surr undings or from the surroundings to the pipe. Insulation serves other purposes, as well, including comfort and safety of personnel.

Several qualities are desirable in an i. sulating material for pipe lines, some are essential. Obviously the material must not deteriorate at the temperature of the pipe. It should be strong enough of itself or be constrained to maintain its physical shape and its insulating properties. It should be nearly airtight for hot lines, absolutely tight for cold lines where ondensation would freeze and destroy the insulation. It should be able to resist occasional wetting and retain a reasonably good appearance. It is desirable that insulation be easy to apply and not too difficult or expensive to remove and replace.

High temperature—For steam or other piping at temperatures over 700 F it is customary to use built-up insulation consisting of two or more layers of different materials. The inner layer of pipe covering must be able to stand full temperature, while the outer layer or lavers are much cooler. In general, materials for very high temperatures are more costly and have higher coefficients of heat transfer (poorer insulating qualities) than other materials which will not stand the high temperature. Therefore, it is not only more economical to use built-up layers, but the resulting insulation thickness is less for the same heat loss. A definite minimum thickness of high-temperature insulation is required to protect the lower-temperature material; stand-

TABLE III—PRINCIPAL STANDARD PIPE SPECIFICATIONS

Pipe	*ASA Number*	*ASTM Designation*
Welded and Seamless Steel Pipe	B36.1–1936	A53–36
Lap-Welded and Seamless Steel Pipe for High-Temperature Service	B36.3–1936	A106–36
Electric-Fusion-Welded Steel Pipe for High-Temperature and High-Pressure Service	.....	A155–36
Electric-Fusion-Welded Steel Pipe (sizes 30 in. and over)	B36.4–1936	A134–36
Electric-Resistance-Welded Steel Pipe	B36.5–1935	A135–34
Forge-Welded Steel Pipe	B36.6–1935	A136–34
Welded Wrought Iron Pipe	B36.2–1934	A72–33
Riveted Steel and Wrought Iron Pipe	B36.8–1935	A138–34
Electric-Fusion-Welded Steel Pipe (sizes 8 to 30 in.)	B36.9–1936	A139–36
Seamless Alloy-Steel Pipe for Service at Temperatures from 750 to 1100 F	.....	A158–36
Cast Iron Soil Pipe and Fittings	.....	A74–29
Cast Iron Pipe and Special Castings	.....	A44–04
Copper Pipe	.....	B42–33
Brass Pipe	.....	B43–33
Copper Water Tube	H23.1–1934	B88–33
Seamless Copper Tubes	.....	B75–30
Federal Specification for Copper Water Tube (up to 6 in.)	WW–T–799	
Federal Specification for Pipe, Steel, Welded and Seamless	WW–P–403	
Federal Specification for Pipe and Fittings, Soil, Cast Iron	WW–P–401	
ASME Specification for Welded and Seamless Steel Pipe	S–18	
Bureau of Marine Inspection and Navy Specification for Lap-Welded and Seamless Steel Pipe	.....	
Navy Dept. Specification for Pipe, Steel, Seamless and Welded	44–P–10g	
ARA Mechanical Division Specification for Pipe, Furnace-Welded, Electric Resistance-Welded and Seamless Steel	M–111–36	
Navy Dept. Specification for Pipe, Iron, Wrought	44–P–11d	
ARA Mechanical Division Specification for Welded Wrought Iron Pipe	M–306–36	
Bureau of Marine Inspection and Navy Specification for Welded Wrought Iron Pipe	.....	
ASTM Specification for Steel Suitable for Welding	.....	A151–36
ASME Boiler Code Specification for Welded Wrought Iron Pipe	S–19	
Federal Specification for Pipe, Wrought Iron, Welded, Black and Galvanized	WW–P–441	
Navy Dept. Specification for Pipe, Iron, Wrought	44–P–11c	
American Petroleum Institute Specification for Line Pipe	5L and 5A	
Flanges and Fittings		
Forged or Rolled Steel Pipe Flanges for High-Temperature Service	G17.3–1936	A105–36
Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves, and Parts for Service at Temperatures from 750 to 1100 F	.....	A182–36
Castings, Carbon-Steel, for Valves, Flanges and Fittings for High-Temperature Service	G17.1–1936	A95–36
Heating and Piping Contractors National Association Standard for Welding Neck Flanges, Standard and Extra Heavy Pipe (1929)		
Pipe Flanges, Forged or Rolled Steel, for High-Temperature Service	G17.3–1936	A105–36
Castings, Alloy-Steel, for Valves, Flanges and Fittings for Service at Temperatures from 750 to 1100 F	.....	A157–36
ASA Steel Flanged Fittings and Companion Flanges	B16a, b, c	.....
Malleable Iron Castings	.....	A47–33
800-Lb Hydraulic Cast Iron Flanged Fittings		
Refrigerating Machinery Manufacturers' Association Ammonia Pipe Flanges and Flanged Fittings Standard (up to 300 lb per sq in. — 1931)		
Alloy-Steel, Bolting Material, for High-Temperature Service	G17.2–1934	A96–33
American Tentative Standard for Wrench-Head Bolts and Nuts and Wrench Openings		

ard sectional coverings are now available made in accordance with this requirement.

It is general practice to cover the loose, fibrous insulating materials, such as asbestos and 85% magnesia, with a finishing material. Most common is a sewed jacket of 8-oz canvas over sized paper or asbestos paper. Other alternates range from hard-finish asbestos cement to a complete metal jacket.

Moderate Temperature — (300-600 F). Most widely used in this service is 85% magnesia (carbonate of magnesia bonded with asbestos fibre) molded and machined into block form or into sections 3 ft long to fit various sizes of pipe. Several manufacturers offer alternate proprietary sectional insulating blocks the content of which is principally asbestos with filler material with suitable outside covers for mechanical protection and waterproofing. Several good plastic cements having as good insulating qualities as 85% magnesia are available for use around fittings and other irregular pipe sections.

Low Temperature — (100-300 F). For low-pressure steam lines, heating and hot water, relatively cheap insulations are often adequate. A reasonable thickness of material is required for mechanical strength and appearance; insulating qualities are not required to be as great as for higher temperatures. Also the material itself does not have to stand high temperature. These factors combine to permit use of corrugated felts and asbestos papers prefabricated in sectional form. In the lower part of the range, hair felt and wool felt offer alternates.

Anti-sweat—Only a thin layer of insulation is required to prevent condensation on ordinary cold-water lines. The principal requirements of such insulation are that it be waterproof and practically airtight to prevent an accumulation of moisture within the insulation which will occur even from slight infiltration of moisture-laden air.

Refrigerants — Extreme low temperatures require adequate insulation thickness because of the relatively higher cost of producing cold as compared with producing heat. Airtightness is accomplished by applying insulation in several layers, with sealing compound between layers and at joints, a field in which experience in correct application of the right material is essential.

TABLE IV—INSULATING MATERIALS

Insulating materials come in several forms: molded, plastic, cloth or paper and granular. A list of commonly used materials:

Material	*Form*	*Service*
Silica and Asbestos	Block and sections	To 1500 F
Felted Asbestos	Sheets, blocks and sections	To 700 F
85% Magnesia	Blocks and sections	To 600 F
Felted Rockwool	Sections	To 1000 F
Cellular Paper (asbestos)	Sections	To 300 F
Plastics	Cement	Varied from 600 F to 1800 F
Wool Felt	Blanket	200 F
Hair Felt	Blanket and sections	200 F
Cork	Sections	100 F
Rockcork	Blocks and sections	100 F
Rockwool	Sections	100 F
Glass Wool	Sections	.....
Expanded Mica	Granulated	.....
Crimped Metal	Sections	.....

TABLE V—GASKET MATERIALS

Fluid Conveyed	*Service*	*Gasket Material*
STEAM (Also Boiler Blowoff)	Exhaust	Comp. asbestos
	Saturated	Comp. asbestos or corrug. copper
	Superheated—up to 600 F	Comp. asbes., corrug. Monel, soft Monel or soft steel
	Superheated—over 600 F	Soft steel, Monel or silver or finished-steel faces
WATER	Boiler feed	Comp. asbes., corr. copper or Monel
	Hydraulic	Hard fiber
	Cold-circulating	Cloth inserted or red rubber
	Suction and discharge	Red rubber
	Service, city and fire	Red rubber
	Hot	Comp. asbestos
OILS	Heavy cold	Paper or comp. asbestos, synthetic rubber
	Light—gasoline, kerosene	Asbestos impregnated with graphite, paper, bakelite, synthetic rubber
	Benzol	Composition asbestos
AIR AND GAS	Hot	Composition asbestos
	Cold	Comp. asbestos, red rubber
AMMONIA	Hot	Thin asbestos
	Cold	Sheet lead
ACIDS		Sheet lead or alloy steel
BRINE		Red rubber

CATALOG BIBLIOGRAPHY

Many pipe, valve, fitting and specialty manufacturers, and several fabricators, have prepared excellent catalogs and bulletins on piping and piping systems, containing a variety of data useful to the engineer designing or operating piping systems. A partial list follows:

Crane Co Catalog No. 52—Valves, Fittings, Pipe and Fabricated Piping.

Crane Co—Pipe & Pipe Bends (Price $1) (also other engineering bulletins and monthly "The Valve World.")

Edward Valve & Mfg Co Catalog No. 11-A10—Valve Material Specifications and Standards.

Fisher Governor Co—Automatic Control Specialties.

National Tube Co—General Catalog.

Youngstown Sheet & Tube Co—Booklet No. 51—Steel Pipe.

Youngstown Sheet & Tube Co—What We Make and How We Make It.

Jones & Laughlin Steel Corp—Catalog No. SP-3—Tabular Products.

National Valve & Mfg Co—Piping Catalog, Edition No. 7.

American Cast Iron Pipe Co—American Pipe Manual, 10th Edition.

National Tube Co Bulletin No. 10—Power Plant Piping.

Mueller Brass Co Catalog G—Streamline Solder Fittings & Copper Pipe.

American Brass Co—Roughing-In Dimensions for Anaconda Fittings, Wrought & Cast.

National Tube Co—Properties of Steel Pipe & Tubes for HT & HP Service.

A M Byers Co—Various engineering bulletins on wrought-iron pipe.

Republic Steel Co—Engineering bulletins on Toncan iron pipe.

Carpenter Steel Co—Helpful Data on Properties & Use of Stainless Welded Tubing.

Jenkins Bros—Catalog No. 23—Valves and Mechanical Rubber Goods.

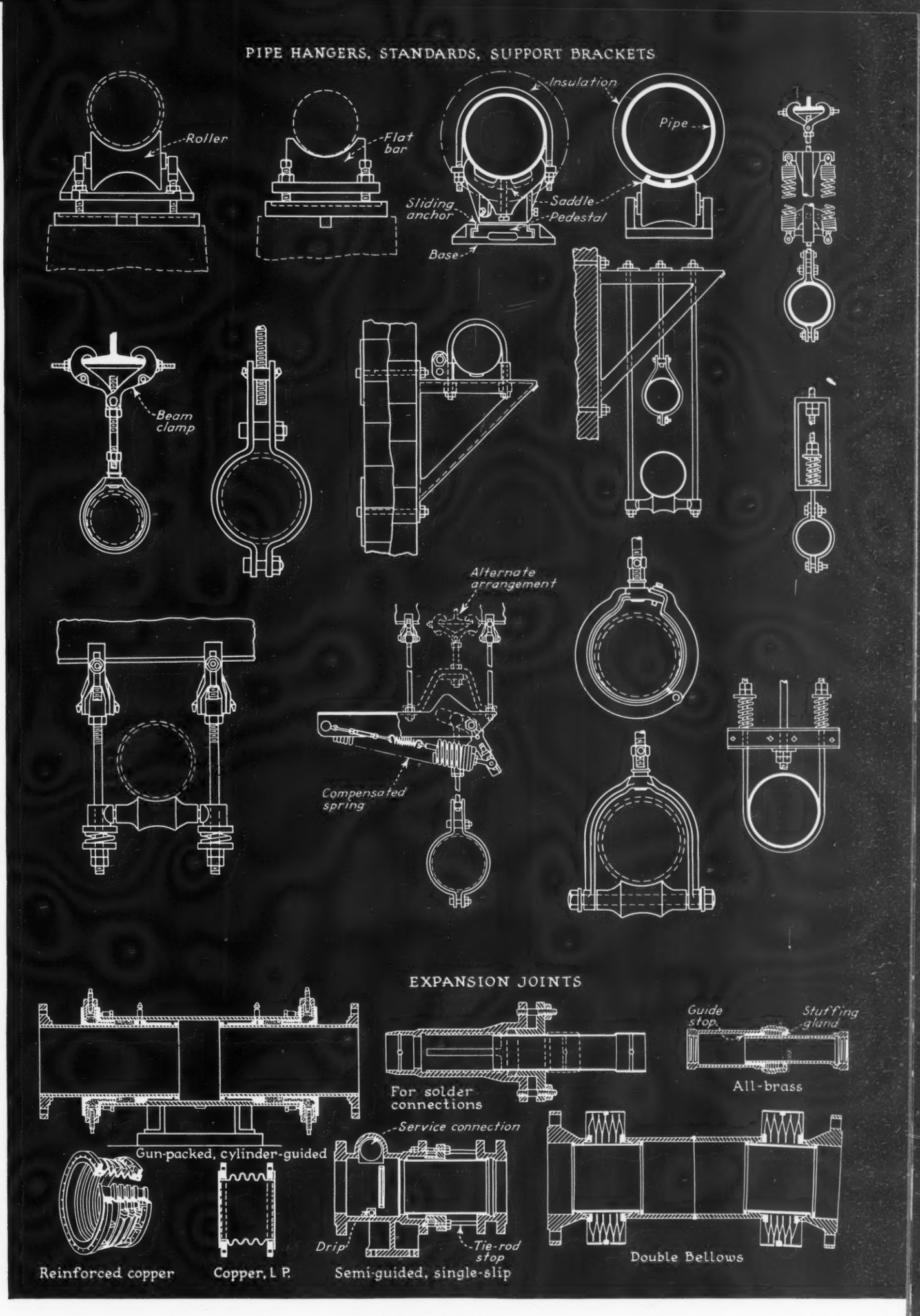
The Wm Powell Co—Catalog No. 11—Valves.

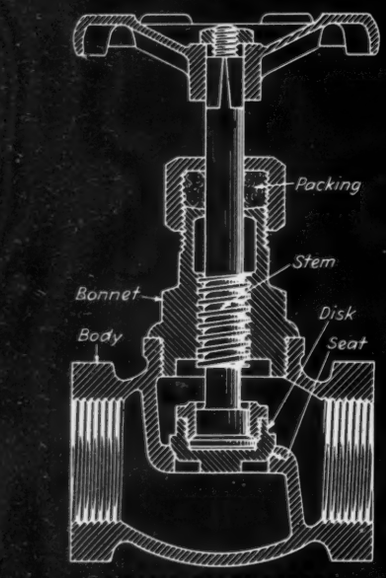
Armstrong Machine Works—The Armstrong Steam Trap Book.

Haynes Stellite Company—Hard-Facing with Haynes Stellite Products.

Grinnell Company—General Catalog.

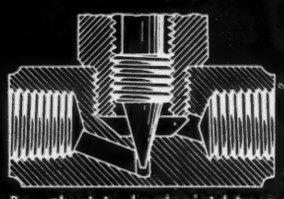
Parker Appliance Company—Tube Couplings—Bulletin No. 35.


PIPE HANGERS, STANDARDS, SUPPORT BRACKETS
Roller
Flat bar
Insulation
Pipe
Sliding anchor
Saddle
Pedestal
Base
Beam clamp
Alternate arrangement
Compensated spring
EXPANSION JOINTS
Guide stop
Stuffing gland
For solder connections
All-brass
Service connection
Gun-packed, cylinder-guided
Drip
Tie-rod stop
Double Bellows
Reinforced copper
Copper, L P.
Semi-guided, single-slip

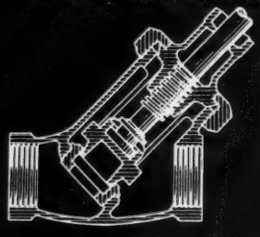


VALVE ESSENTIALS

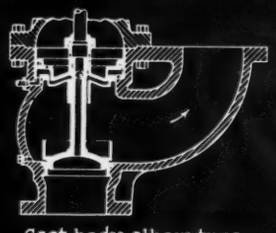
BODY TYPES



Bar-stock body, straight type

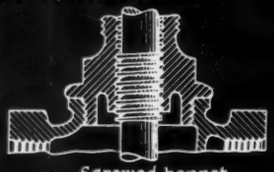


Cast body, "Y" type

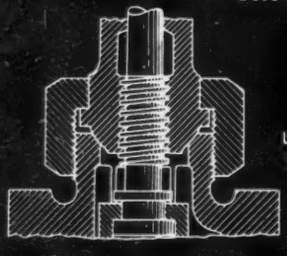


Cast body, elbow type

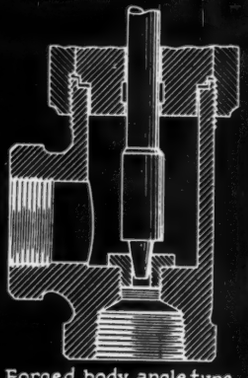
BONNET CONNECTIONS



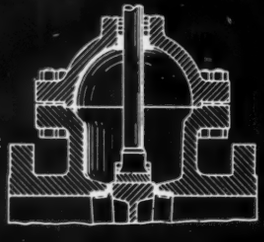
Screwed bonnet



Union bonnet
(Ground joint)

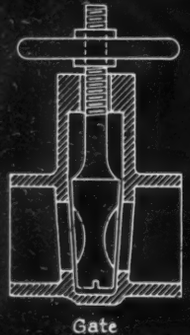


Forged body, angle type

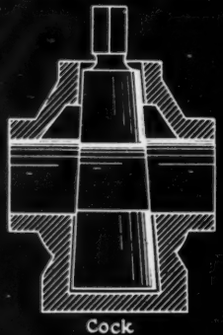


Bolted bonnet

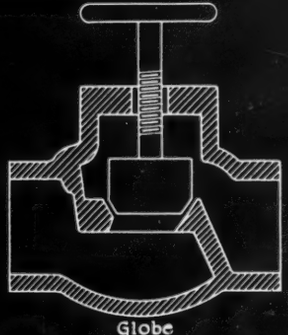
SCHEMATIC SEAT AND DISK ARRANGEMENTS



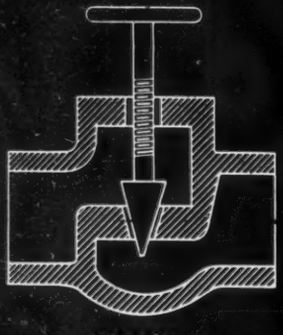
Gate



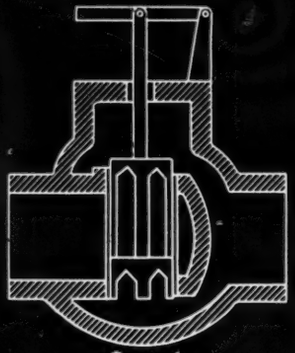
Cock



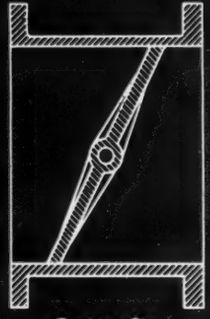
Globe



Needle



Ported



Butterfly

VALVES

ORIGINALLY, a valve was a crude device acting like a gate or door, to prevent or permit flow in a pipeline. But industrial and power advances have required the handling of fluids at high pressures and temperatures, fluids often highly corrosive or erosive. Engineers needed valves to perform more complicated functions with a minimum of human attention. Valves had to get tougher and more versatile to meet these demands. Today a bewildering array, tailor-made to meet all kinds of special conditions, is available. New and radical designs, incorporating materials unknown to the early engineers, challenge the most severe conditions of modern industry. Today valves represent a heavy part of the investment in any piping system. It is now more important than ever to know the field and to make an intelligent selection.

This section brings together scattered information. It cannot be exhaustive; several books would be required to do that kind of job. It can, however, present a clear and coordinated picture of the valves the power engineer encounters, how they're built and how they're used.

Family Resemblance

All valves, however specialized, bear a sort of family resemblance, and are constructed of certain recognizable elements. A body is necessary to provide a path for flow of the fluid and to act as a foundation on which the other elements can be assembled. The interior of the body is made accessible by a removable section known as a bonnet. The valving function is performed by a moving element, usually referred to as a disk, which acts against a seating surface. A stem connects the disk with the operating agency, either human or mechanical. To seal the opening where the stem passes through the bonnet, some sort of packing arrangement is necessary. Body, bonnet, disk, seat, stem, and packing—these are the essential elements. The design of each represents a problem in material selection and proportioning for strength; the completed valve a problem in harmonizing frequently conflicting requirements.

Service Conditions & Ratings

Pressure, temperature, and the nature of the fluid to be handled are the important factors in rating a valve. Pressure alone is no great problem; piping systems operating at 2000-3000 lb per sq in., handling water or relatively inert gas at or near atmospheric temperatures, are not uncommon, and valves are produced commercially for hydraulic pressures in excess of 6,000 lb.

Temperature is the great bugbear, but closely allied with it is the problem of handling corrosive fluids, since many normally inoffensive materials become highly corrosive at elevated temperatures. Temperature and chemical attack present special difficulties because of the changes in the physical properties of materials ordinarily used in piping systems when temperature is increased beyond a certain point. What happens to metals at high temperatures and how have piping and valve engineers met these conditions?

In the first place, virtually all materials, ferrous and non-ferrous, decrease markedly in strength at elevated temperatures. Some increase in strength at first as temperature is increased but fall off rapidly after passing a given temperature. Others decrease in strength all the way, but usually at an accelerated rate after passing a certain temperature. This effect is always present at elevated temperatures regardless of the duration or frequency of subjection to such temperature.

Repeated or continuous exposure to high temperatures produces other effects, however. Cast iron, malleable iron, and semi-steel, if repeatedly heated to temperatures of 500 F or higher will exhibit a slow, constant increase in volume, known as "growth." A marked decrease in strength accompanies this effect. Brasses and bronze are also believed to show the same characteristics. In the first case, growth limits the use of iron since it occurs at a lower temperature than is required to produce a marked decrease in strength due to instantaneous or one-time heating. In the case of brass and bronze, growth is believed to occur at about the same temperature as a marked decrease in strength. This probably explains the lack of definite data on the growth of brass and bronze, since the decreasing strength characteristic, long known, has barred their use under conditions where growth might occur.

The use of metals in piping systems operating at extremely high temperatures and pressures has focussed attention on another characteristic known as "creep." Creep occurs in metals subjected to long, continuous load at high temperature and constitutes a form of plastic flow which results in gradual and progressive distortion until failure results. It is probable that some creep takes place at all temperatures but is so slight at low temperatures as to be undetectable over reasonable periods of time. The rate of creep for any given load increases with extreme rapidity at elevated temperatures. In this connection it is important to remember that creep is an effect of temperature and stress but that growth is an effect of temperature only.

All of the foregoing serves to explain why the temperature rating of a valve is extremely important, more important in most cases than the pressure rating. Most valve catalogs and data sheets on commercial valves give two ratings. One represents the working pressure for handling water, oil or gas, at or near atmospheric temperatures, and under non-shock conditions. The other rating, probably more familiar to the power engineer, is the recommended working pressure for handling steam and is normally tied in with a temperature. If no temperature is given, saturation temperature is usually understood. Neither rating should be confused with test pressure since valves are usually tested hydrostatically at pressures considerably in excess of the recommended working pressure, and at or near atmospheric temperature.

Bodies

Valve bodies are made out of a wide variety of materials and by several methods of fabrication. Brass, bronze, cast and malleable iron are all used for low-pressure valve bodies, say up to 250-lb steam. Cast-iron bodies are made in all sizes; brass, bronze, and malleable iron are rarely found in sizes above 3 in. For the upper part of the low-pressure range, various hard bronzes are used and iron is strengthened by adding scrap steel to the melt to produce a "semisteel." The exact compositions vary with the manufacturer and are usually designated by trade names.

Valve bodies for service at higher pressures are made of steel. Carbon steel castings are widely used for pressures up to 1500 lb and temperatures up to 750 F. Careful control of composition, sound foundry practice and proper heat treatment are absolutely necessary to produce a casting good for the upper part of this range. For the extreme pressures and temperatures met in the new plants, carbon-molybdenum alloys and other special low-alloy steels are customary. Carbon-moly finds wide application where welded joints are used, because it air hardens only slightly after being heated to welding temperature.

Forging and machining from bar stock are alternative methods of fabrication for small valve bodies designed for severe service. This represents the most economical way to make a high-quality body, in small sizes.

Many alloys are available for valve bodies called on to meet highly corrosive or erosive conditions; it is only possible to mention a few here. Stainless steel, particularly the 18-8 alloy, has excellent strength characteristics, as well as high corrosion resistance. Monel metal is also used, and another nickel alloy, known as "Hastelloy," is particularly suitable for valve bodies designed to handle acid solutions and solutions containing free chlorine. Cast iron, alloyed with nickel, copper and chromium, may be used where the general properties of cast iron are suitable, but greater resistance and strength is desired.

Valve bodies may be lined with resistant materials for corrosive service, and in some cases this method will prove cheaper than making the body from a special alloy. Rubber linings, for example, are acid and chlorine resisting. As a general thing, the best procedure when faced by the problem of selecting valves for handling highly corrosive or erosive materials, is to consult the leading manufacturers and metallurgical organizations, since it is frequently possible to find a material not widely known but exactly suited to the requirements.

Several shapes of valve bodies are available to meet piping layout requirements. The most common is the straight body designed for insertion in a run of pipe. The angle body eliminates the need for an elbow, when a turn is required near the valve. In addition to saving a fitting and a joint the use of the angle body usually saves some pressure drop over a combination of straight valve and elbow. The elbow body also saves a separate elbow and a joint, but does not make any saving in pressure drop in the usual case. The "Y" body is occasionally used.

Bonnets

Bonnets are normally made of the same material as the body. In small sizes, the bonnet is screwed to the body either directly or by means of a union ring. A union ring permits the use of a ground joint for sealing. In high-pressure valves, the gasket is frequently of the ring type, restricted on all sides to prevent blowing. Flat metal gaskets of Monel or mild steel, are also used. All large valves and some small high-pressure valves have a bolted joint between the body and

the bonnet, gasketed of course. For low-pressure service where frequent inspection and cleaning are necessary a clamp-type bonnet may be obtained which requires only the unscrewing of two bolts to remove.

Disks and Seats

The disk and the seat are the heart of any valve. Their relative shapes and the materials of which they are made very largely determine the kind of service the valve is fitted for and the kind of results it will give in that service.

Gate valves and plug cocks are best suited for pure stop-valve service. They seat tightly and when open permit straight-line flow. The gate disk is flat or wedge-shaped and moves between seat rings set in the side of the body perpendicular to the direction of flow. In its simplest form, the plug cock consists of a cylindrical plug with a hole in it, fitted into the valve body. Rotation of the plug brings the hole in line with the flow or shuts it off.

The globe type of valve is commonly used for general stop service and is suitable for infrequent throttling service where close regulation is not required. The interior of the valve body is divided, as shown, and the hole in the dividing wall is closed by a plug or cap. The needle valve is essentially a variation of the globe construction, the plug being replaced by a longer, tapered member which permits closer control of flow between closed and wide open.

The ported valve is widely used for regulating and control service. A cylindrical disk is slotted or ported around the lower edge and when the disk is raised various rates of flow are obtained.

The butterfly valve is balanced by pressure acting on both sides and finds considerable use in handling heavy fluids and those containing solids.

Trim Materials

Conditions of service are different for disks, seats, stems, and thrust collars, consequently these parts are made of different materials from those used for bodies and bonnets. What special service conditions must trim materials be able to stand? In the first place, they must be hard and tough to resist wear from friction; seats and disks must be especially hard to resist indentation and abrasion from sand, grit and scale that may be caught between their surfaces. A further requirement is freedom from galling. Galling or seizing is apt to occur when two surfaces of the same material and of identical hardness are rubbed against each other under heavy pressure. The result, of course, is rapid wear. Since valve seats are usually inserted into the body, the coefficient of expansion of the seat material must be approximately the same as that of the body so that the seat ring doesn't loosen and leak. Also, differences in expansion between stem and body will cause the disk to loosen on the seat and a second tightening will be required after the temperature change has ceased. Naturally, trim materials must have the tensile properties and chemical stability required of the body.

For low-pressure, low-temperature service, not characterized by excessive corrosion, iron and brass trim is commonly used. In the "all-iron" valve, the seat rings may be inserted or the seat may be cast integral with the body; disk and stem are usually of steel. Brass or bronze trimmed valves have seat rings, disk, gland, and stem of non-ferrous materials. Stainless iron, an alloy of iron and chromium, is recommended for handling steam, oils containing sulphur and for other corrosive fluids.

Many ferrous and non-ferrous alloys are available for trim in the moderate pressure, moderate temperature range. A wide variety of stainless steels, alloys of steel and varying amounts of chromium and nickel, are used, different compositions and heat treatments giving a wide range of hardnesses. Monel, as made from the natural ore, and synthetic alloys of similar composition, are widely employed because of their resistance to certain corrosive media. Stainless iron, mentioned above, is also widely used for high-pressure steam service.

HP, HT Trim

For the most severe conditions of temperature and pressure, 13% chrome steel, nitrided steels and cobalt-chrominum-tungsten alloys are preferred. The latter two are essentially hard-facing operations. Nitriding is accomplished by exposing an alloy steel containing aluminum to ammonia gas at high temperature. Surface hardening takes place to a depth determined by the length of time exposed. The finish produced will easily scratch glass, and resists wear and erosion. The cobalt-chromium-tungsten alloys (Stellite) are deposited by welding. They're extremely hard, but their greatest asset is the ability to retain this hardness at the red heat conditions which exist at the surface of materials in friction. Stellite may be used to repair seats and disks that have failed in service. Grinding is the customary method of finishing nitrided steel or Stellite.

Disks are sometimes made of non-metallic materials, such as rubber compounds, molded asbestos fibre, and phenolic resins. The usual practice is to insert the disk in a metal disk holder in such a fashion that it may be renewed. This combination type of disk is used mainly for low-pressure, low-temperature work, such as hot-water, oil and gasoline lines.

Most globe valves are built so that the disk and seat may be reground and also renewed when necessary. Such an arrangement results in real economies when wear on disk and seat surfaces is severe and tightness is required.

Stem Arrangement

Most manually-operated valves with the exception of quick-opening and lever-operated valves, are operated by a threaded stem and handwheel. The screw may be inside the bonnet or outside, and the stem may or may not rise. In the rising-stem, inside-screw type, the threaded portion of the stem engages threads in a bushing or in the bonnet. The end of the stem rotates in a thrust collar which is part of the disk. The situation is reversed in the non-rising stem, inside-screw type. The stem rotates in a thrust collar mounted in the bonnet and is threaded into the disk.

Outside-screw valves have been most widely used in recent years. This style of construction involves the use of a yoke above the bonnet. The most common arrangement is that in which the upper part of the stem is threaded into a nut fixed in the handwheel. The nut rotates in thrust collars in the yoke. Rotation of the handwheel thus causes the stem to rise and the valve to open. In some cases the stem is threaded through a nut in the yoke and the handwheel is fixed at the top of the stem. In this case the handwheel rises with the stem. Practical considerations, such as headroom, interference, and nature of service are likely to determine the choice of stem arrangement.

Thrust Collars

To reduce the amount of power necessary to operate large valves and to increase life, thrust collars and other bearing surfaces are sometimes equipped with ball bearings and pressure-lubricated fittings.

With the rising-stem, inside-screw construction, sealing is effected by packing the stem in a stuffing box that is a part of the bonnet. A gland and packing nut complete the assembly. A separate stuffing box, screwed to the bonnet, is required for the non-rising-stem construction to permit removing the stem. In other respects the packing arrangement is similar to that of the rising-stem type. Outside screw and yoke valves have a stuffing

box integral with the bonnet to which the gland is bolted.

Suitable design of the top of the disk will permit it to seat against the upper part of the bonnet when in the wide-open position, thus sealing the pressure in the valve, allowing repacking without interrupting service.

For handling refrigerants where tight sealing is essential, specially designed valves with a sealing cap are sometimes employed. The handwheel is detached and the sealing cap is fitted over the stem, screwing on threads provided on the outside of the stuffing box. Sufficient height is available under the cap to allow the stem to be fixed at the position of maximum rise. Operation of the valve requires removal of the cap, but leakage of refrigerant past the packing is prevented between operations.

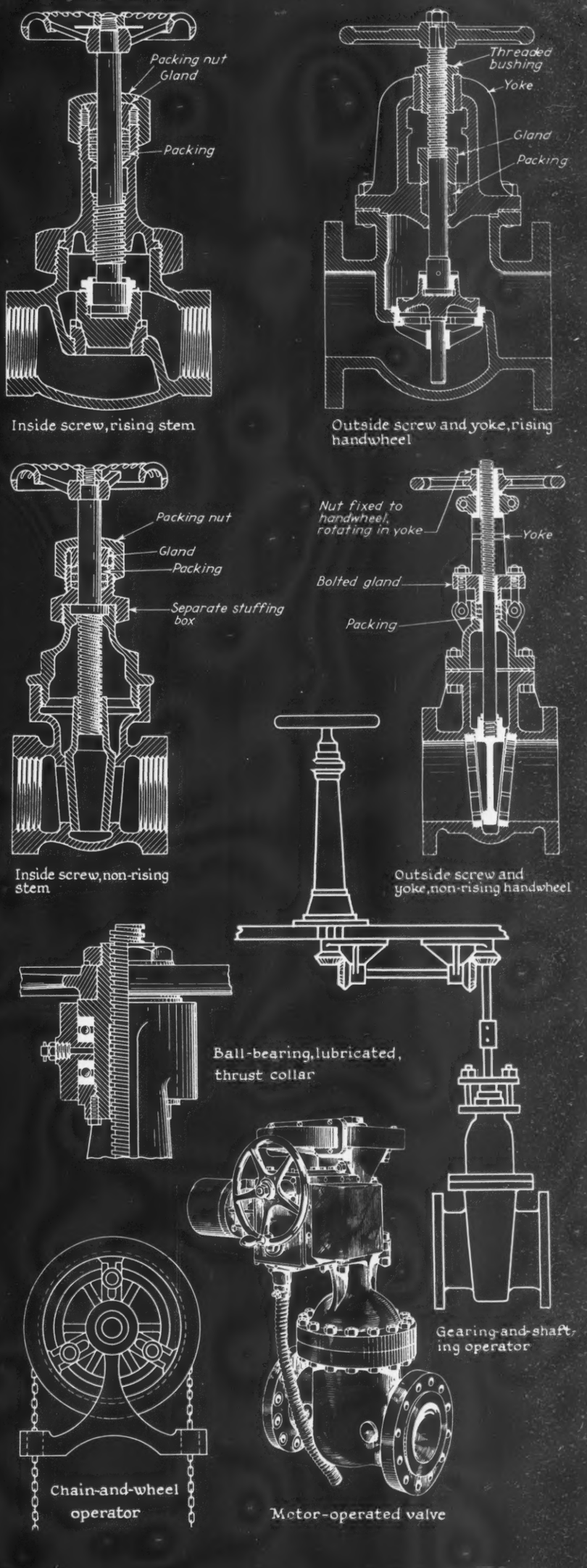
Valve Operation

The majority of all valves installed are arranged with a handwheel for direct manual operation. Where the valve is to be installed in an inaccessable place, it is frequently equipped with a chain and wheel, or combinations of gearing and shafting may be employed. For quick and easy opening, various lever arrangements may be obtained.

Large valves present special problems because of the power required to open and close them under pressure. Various types of mechanical operators overcome this difficulty and make possible remote valve operation.

Two systems are used, each being adaptable to a number of power sources. The arrangement most common on automatic valves of various kinds is pilot control; that is, motion of a pilot valve controls the admission of air, oil, or water, under pressure, to a piston operating the main valve stem. The system generally used for remote or local operation of a valve, under human direction, employs either air, gas, oil, or electric motors to supply the power required. The essential feature of this system is the method for limiting motion in either direction. Normally, stopping of the motor in the opening direction is affected by a mechanical limit switch. To insure tight seating, a different type of switch control is needed for the closing direction. This is usually a torque-limiting device adjusted to seat the valve under the desired pressure.

Solenoid operators are used where open-shut operation is desired; motion of the valve is controlled by energizing a magnet surrounding a solenoid attached to the stem. This type may be applied directly to balanced or semi-balanced valves or to a pilot valve controlling a large main valve.



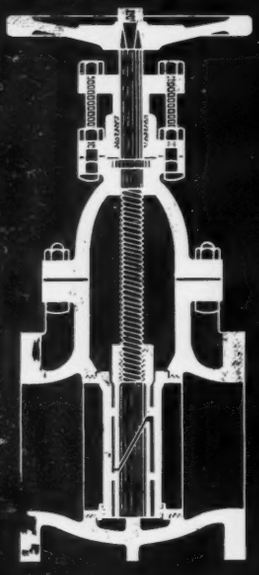


Fig.1-Parallel-seat gate

Fig.2-Principle of split wedge

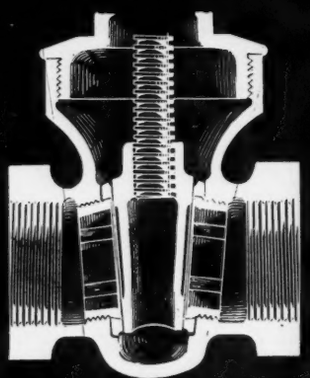


Fig.3-Renewable-seat gate, retaining-ring type

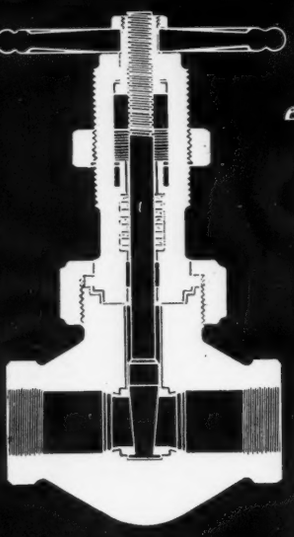


Fig.4-High-pressure forged gate

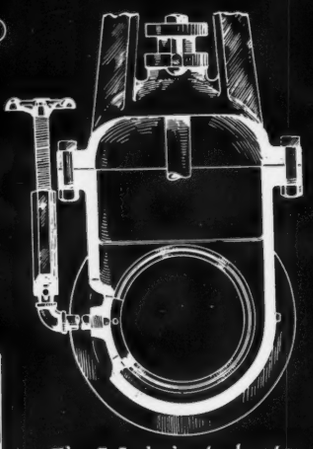


Fig.5-Lubricated gate

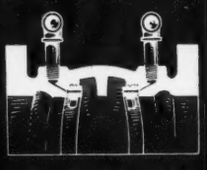


Fig.6-Detail of lubricated gate

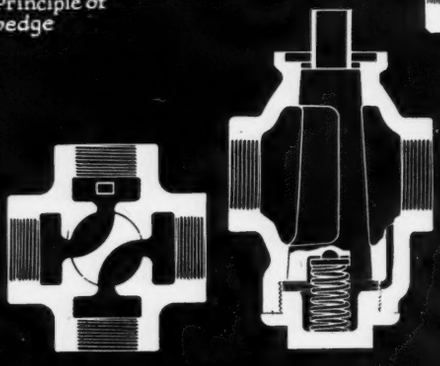


Fig.8-4-way cock

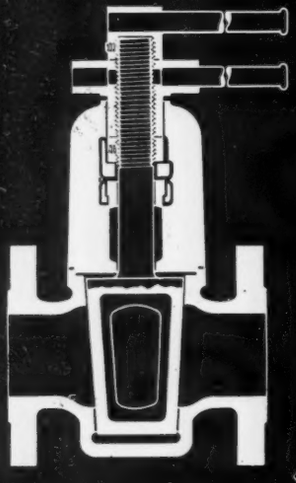


Fig.7-Plug cock

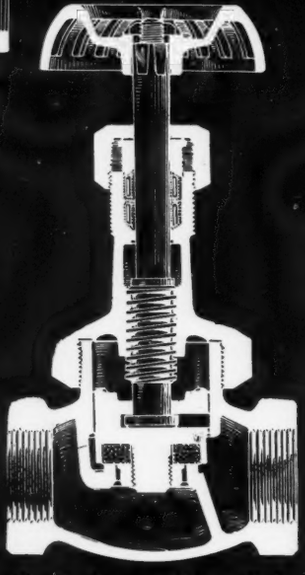


Fig.9-Composition-disk globe

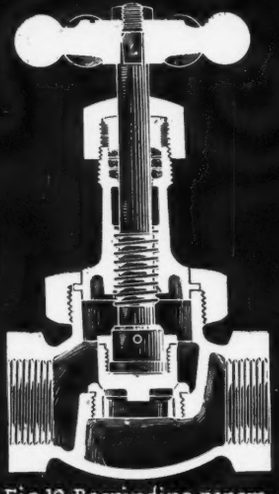


Fig.10-Regrinding, renewable-disk globe

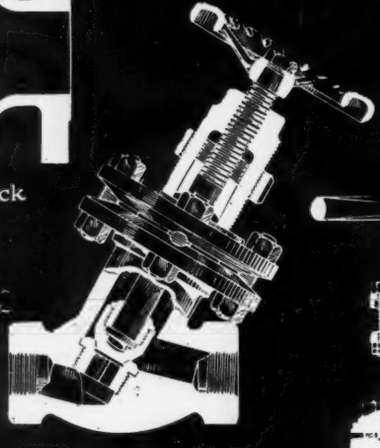


Fig.11-Straightway-body globe-high-pressure

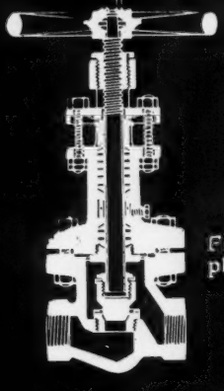


Fig.12-Globe with plug disk-high pressure

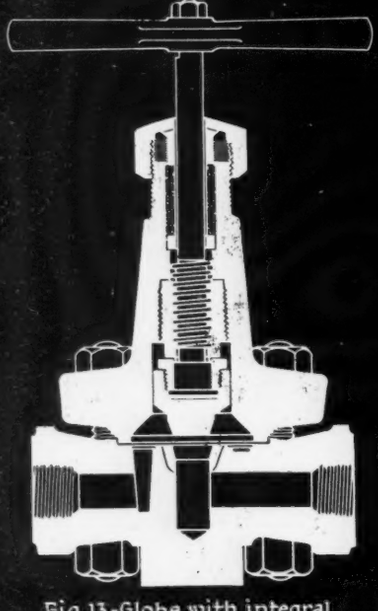


Fig.13-Globe with integral Stellite seat

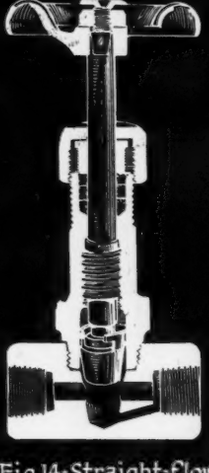


Fig.14-Straight-flow bar-stock

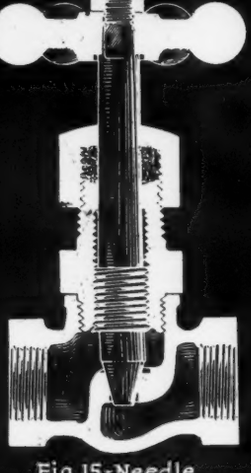


Fig.15-Needle

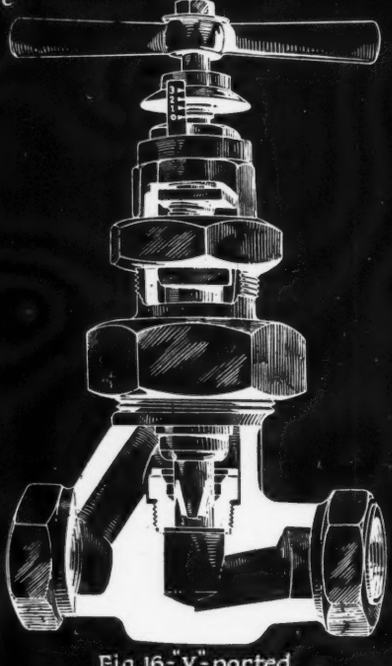


Fig.16-"V"-ported

STOP AND THROTTLING VALVES

THE GATE VALVE is an ideal stop valve; ideal for service where it is wide open or fully closed for long periods of time. When open it offers least resistance to flow; when closed, it seats tightly.

Simplest form of gate valve is the solid-disk, screwed-bonnet valve. Seat rings are cast integral with the body, the disk is wedge-shaped or tapered. A less commonly used type is the parallel-seat valve, Fig. 1. The disk consists of four members, two faces and an upper and lower spreader. Parts are keyed together in such a fashion that the spreaders which have angled ends, push the faces apart and against the disk when the stem is screwed down. The detail, Fig. 2, shows in a rough way, the principles involved. In this case, the seat rings are screwed into the body and are thus renewable. A 2-piece construction may be used for renewable rings, in which a screwed-in retaining ring holds the seat ring in place, Fig. 3. Thin gaskets are placed back of the seat ring to prevent leakage between ring and body.

HT, HP Service

For high-pressure, high-temperature service, various refinements of design are employed. The valve in Fig. 4 has a forged-steel body of rugged design, with union bonnet. Seat rings are rolled in place and can be easily reseated. Trim of Monel, stainless steel or Nitralloy may be used, as preferred.

The gate valve is particularly hard to keep tight when exposed to severely corrosive service. A valve with a lubricated seat has been developed to meet this problem, Fig. 5. A standard gate valve is equipped with grease guns which force lubricant past a ball-check valve into a groove under the seat rings, Fig. 6, from which it flows to the seating surfaces through small holes. An annular groove in the face of the seat ring distributes the lubricant to the entire surface.

The plug cock is often used for tough stop-valve service. The simplest type of plug cock has a ground joint between the disk and the seating surfaces, Fig. 7. In another type, a renewable asbestos bushing is employed. Bushing elasticity compensates for differential expansion between plug and body and insures a tight joint. Lubrication is depended on to insure tightness in a third type. A screw set in the stem forces grease through the ball check valves, and through ducts to clearances between tapered plug and body. Some grease finds its way to the bottom of the valve, preventing sticking.

A secondary service which plug cocks perform is directing flow. The 4-way cock, Fig. 8, is an example.

Globe valves are frequently used for stop-valve service, particularly if some throttling is required and if increased resistance is no great loss. The globe valve has the further advantage of being quickly and conveniently reground and reseated. For straight stop-valve service, the globe valve equipped with composition, Fig. 9, or renewable metallic disks has certain advantages. One line of valves may be used for many services simply by equipping them with the proper disks, and the disks may be readily renewed. Composition disks are apt to cut out quickly on throttling service. A typical conical-seated globe valve is illustrated in Fig. 10. The valve may be reground by placing a pin in the hole through the disk and stem, which will permit the disk to be rotated against the seat. Both seat and disk are renewable.

Where the globe valve is to be used for throttling service, a plug-type disk and seat with the seating surfaces carefully proportioned will give good results. The valve of Fig. 12 is designed for severe throttling service at high pressure. Body and bonnet are forged carbon-moly steel, stem and seat ring are stainless iron, and the disk is nickel alloy. The stuffing box is of the lantern type with cooling chamber. Fig. 11 is a plug disk globe valve with a straightway body, also designed for high-pressure service.

An interesting development of the globe type for high-temperature, high-pressure service is a valve with an integral Stellite seat, Fig. 13. The seat is deposited by welding, and in order to make this possible the break between body and bonnet has been made at the seat line. This makes the seat available for relapping, regrinding or re-Stelliting. Integral construction minimizes chances for leaks between seat and body. The plug-type disk is stainless steel.

A novel bar-stock valve, Fig. 14, designed to handle heavy fluids carrying solids or likely to deposit scale or precipitates, has a straight-through path of flow.

It is often desirable to control throttling more closely than is possible with any of the valves previously mentioned. The most commonly used valve for close regulation is the needle valve, Fig. 15. The greater length and smaller taper of the disk produce a small change in opening for a given amount of stem lift. For even more accurate work, the "V"-port disk is employed, Fig. 16. Almost any relation between flow and stem rise can be obtained by varying port shape and size. The valve illustrated is for high-pressure, high-temperature service, and is made of forged steel, disk and seats being stainless steel. Note that calibration is possible and that the valve has an indicator dial and scale.

BLOWOFF VALVES

USE OF BLOWOFF VALVES of a specified character is required by most boiler codes, and two separate and distinct valve mechanisms in series are required by many on boilers above the low-pressure range. Globe-type valves, or any construction likely to hold sediment, are not usually permitted. Blowoff valves must close drop-tight against high pressures and must withstand the erosive action of impure hot water, expansion and contraction strains due to rapid and extreme temperature changes, and water hammer.

The straightway or "Y" body design offers one means of achieving free flow with a minimum of sediment-collecting obstructions. Fig. 1 (next page) is a cast-steel valve of this pattern for moderate-pressure service. Similar freedom from obstructions is obtained with the angle body, also a common construction. An angle-body valve of the hollow-piston seatless type is shown in Fig. 2. The shoulder on the piston compresses the packing when screwed down. Either seating arrangement can be obtained in either body type.

Where two valves are required, the guard valve is frequently of different construction, since it normally serves a pure stop function. Occasionally a standard gate valve is used, but more frequently a swing-gate is installed. Fig. 3 is of this type, with the disk shown in detail. The sealing bushing is held against the disk by the spring. Cocks are also widely used as guard valves in tandem combinations, Fig. 4. The heavy spring holds the tapered plug tightly seated, and unseating before opening is effected by moving the lever forward before rotating it.

For high-pressure service, various refinements of design are employed to withstand severe conditions. Fig. 5 is a forged steel valve with flanges screwed and welded to the body. The

Fig.1-Straightway-body, plug-disk blowoff

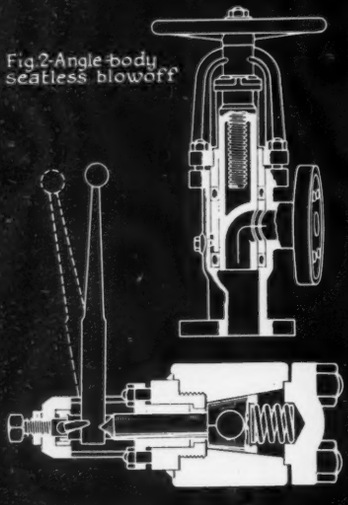


Fig.2-Angle-body seatless blowoff

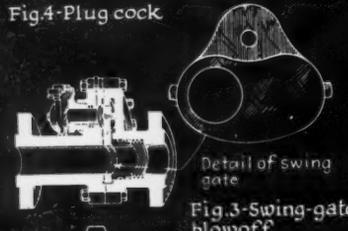


Fig.4-Plug cock

Detail of swing gate

Fig.3-Swing-gate blowoff

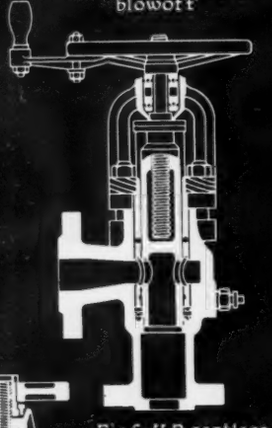


Fig.6-H P seatless blowoff

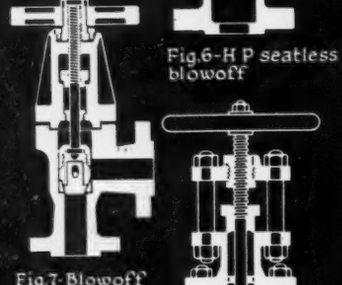


Fig.7-Blowoff with auxiliary disk

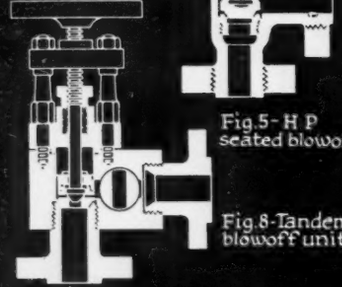


Fig.5-H P seated blowoff

Fig.8-Tandem blowoff unit

yoke is not integral with the bonnet but is built with separate yoke posts as shown. The plug disk is stainless steel, heat-treated for resistance to corrosion, and may be Stellite-faced for extremely tough service. The seatless valve, Fig. 6, is of the balanced type; an annular space in the body permits pressure to surround the plunger. Body is forged steel, outlet nozzle is screwed and welded. Yoke is cast, steel, trim is stainless or Nitralloy. To save the main disk from the effects of wiredrawing, the valve of Fig. 7 has a 2-part disk; as the valve opens the upper part lifts off the seat, but flow is prevented by the lower part until the upper is out of the throttling range. The upper disk is depended on for tightness, the lower or check disk, takes the severe abrasion.

Various body patterns and seating arrangements are combined in making tandem-valve units. Convenience in arranging piping determines to a great extent the body combinations, and engineering preferences dictate whether two seated valves, a seated valve and a seatless valve, two seatless valves, or a plug cock with either seated or seatless valve will be used. Bodies are commonly bolted together for tandem service, but are frequently furnished welded together, saving a joint.

Tandem valves are also made up in a single body, a construction that makes for simplicity and compactness in some installations. One of a number of such combinations is illustrated in Fig. 8. The outlet valve is designed to overcome erosion troubles by the use of an auxiliary, Stellite-tipped disk which opens first and is always opened wide. The small discharge thus started may be adequate for all purposes if blowdown is frequent, thus requiring the opening of the main valve only for draining or for heavy blowdown. The inlet valve is a solid cylinder, journalled on both ends. Clearance between body and cylinder is filled with a graphite-base packing, maintained by a feedscrew on the stem.

CHECK AND NON-RETURN VALVES

CHECK VALVES are the one-way signs of fluid highways. Swing-check valves are commonly used, especially for low- and moderate-pressure service. Figs. 1 and 2 (next page) are typical low-pressure swing-check valves, with the hinged disk held off the seat by flow in one direction and against the seat by reverse flow. A swing-check valve of different construction, known as a "tilt" check, Fig. 3, is designed to lower resistance to flow, to seat without slamming, and to stay tight in service. For light pressures and large flows, such as in the exhaust from engine to condenser, a balanced check, Fig. 4, may be used.

Lift Checks

The other general class of check valves employs a lifting disk rather than a swinging one. A globe-type check valve for low-pressures is illustrated in Fig. 5. The conical disk, of nickel-bronze, is regrindable and renewable, and is guided both above and below the seat. Fig. 6 is a lift check with a piston disk which also acts as a dashpot, cushioning the action. Figs. 7 and 8 are high-pressure piston checks, the former having an angle body, the latter a "Y" body. For small valve sizes, a ball may be used as a disk, the result being called a ball-check valve. In a high-pressure valve of this type, Fig. 9, both ball and seat are stainless steel. A cage or guide chamber controls the motion of the ball.

The non-return or stop-check valve is a combination of stop valve and check valve designed for service between boiler and header, or in other locations where such a combination is desirable. As used on a boiler, the check valve prevents backflow into the boiler when pressure drops or when the boiler is down for repairs; the stop function permits cutting out the boiler by manual operation. In the simple, compact, non-return valve for low-pressure service, Fig. 10, the angle "Y" body houses a ported cylindrical liner in which moves a piston-type disk, free to be acted upon by pressure. Screwing down on the stem holds the piston against the seat. Upper part of piston acts as dashpot to cushion motion. Fig. 11 is a globe-type non-return valve for the moderate-pressure range, designed to give large areas for steam passage and minimum resistance to flow. The specially-shaped disk is free to slide on the stem, which is normally raised, permitting the disk to act as a check. The dashpot is located above the disk.

In the high-pressure, non-return, Fig. 12, the carbon-steel piston is fitted with stainless-steel piston rings

and a stainless-steel disk, with inside bevel contact face and throttling plug. Combination angular and radial thrust bearings are provided to withstand heavy loads The handwheel is designed to give mechanical advantage for closing against high pressure. A forged-steel crossarm is locked to the yoke bushing. The handwheel is free to rotate on the upper part of the yoke bushing and is equipped with two integrally-cast steel weights. Turning the wheel back 90 to 120 deg permits delivering heavy blows on the opposite ends of the crossarm. Mechanical advantage for closing under extreme pressure is also sought by means of a toggle mechanism like that in Fig. 13.

Triple-Duty Valve

Protection against a header failure is generally considered desirable, and is sought automatically by means of the triple-duty valve or by means of a remote-controlled, quick-acting, stop valve. Fig. 14 is a triple-duty valve employing a weighted pilot. Boiler pressure under the valve must overcome header pressure above it to open. Reverse flow causes the disk to seat, and a dashpot provides a cushioning action. The weighted pilot valve is held open against boiler pressure by header pressure from the bypass connection and by the shot acting as a weight. Header pressure can fall until its effect plus the weight (adjustable) is less than the boiler pressure. The pilot opens, relieving pressure between the dashpot piston and head. Boiler pressure, acting through the central port in the disk, forces the valve shut.

Another triple duty, Fig. 15, requires no pilot valve. It has two disks, and an external dashpot with balancing lever is employed to cushion the movement. With boiler pressure lower than header pressure, upper disk is forced to seat. When pressures are equalized between header and boiler, the balanced disks rise, taking an intermediate position. Any reduction in header pressure causes the lower disk to seat under boiler pressure.

Remote-Control Valve

An automatic triple-duty valve combined with a device for remote operation, Fig. 16, has a disk operated by a piston in a chamber above. High-pressure steam from the boiler acts down on the piston and is balanced by boiler pressure from the valve inlet. An outlet under the piston is controlled by a valve which, when open, reduces pressure under the piston, closing the valve. By changing the control on this valve the main valve can be made to operate automatically by lowered pressure in the header, by remote manual control, or both.

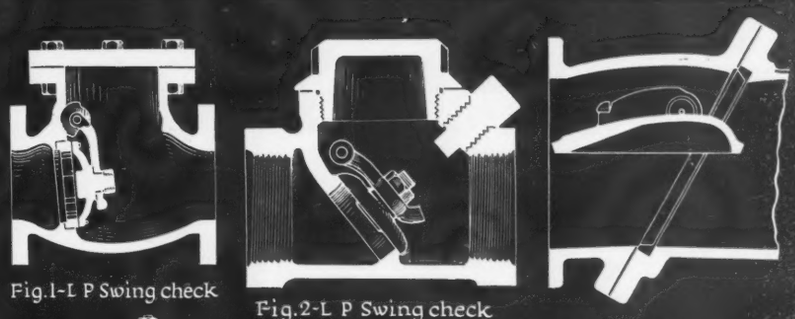


Fig.1-L P Swing check

Fig.2-L P Swing check

Fig.3-Tilt check

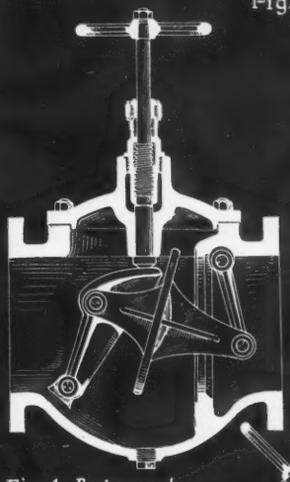


Fig.4-Balanced swing check

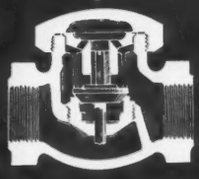


Fig.5-Lift check

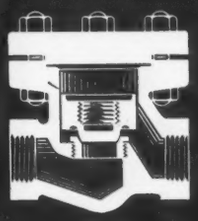


Fig.6-Piston check

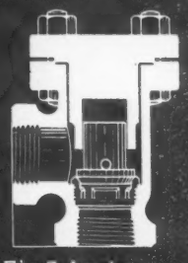


Fig.7-Angle piston check

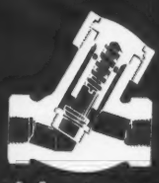


Fig.8-"Y"-body piston check

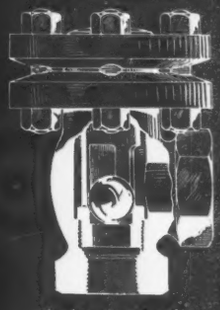


Fig.9-Ball check

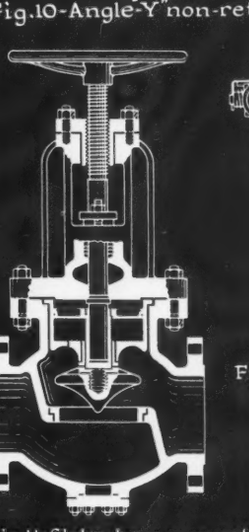


Fig.10-Angle "Y" non-return

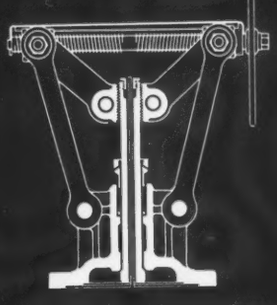


Fig.13-Toggle mechanism

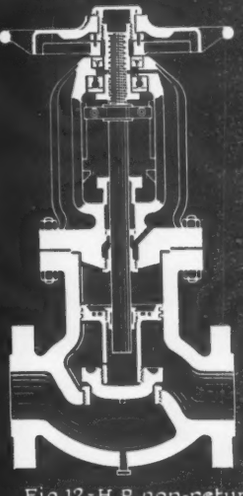


Fig.12-H P non-return

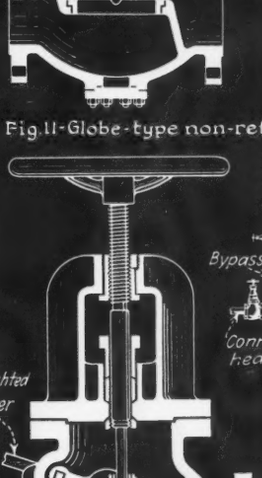


Fig.11-Globe-type non-return

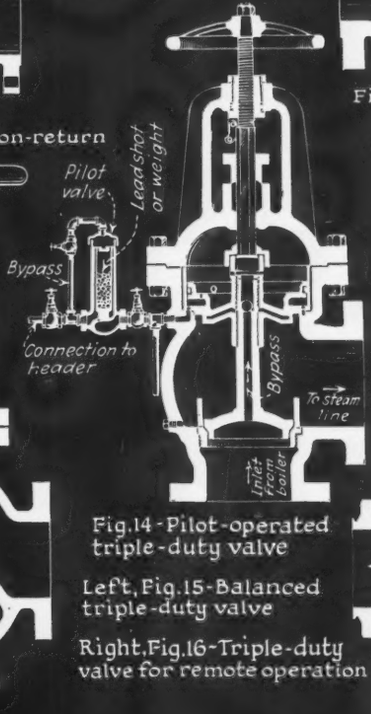


Fig.14-Pilot-operated triple-duty valve

Left, Fig.15-Balanced triple-duty valve

Right, Fig.16-Triple-duty valve for remote operation

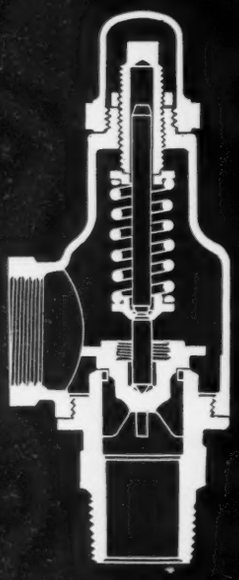


Fig.1-Low-pressure relief valve

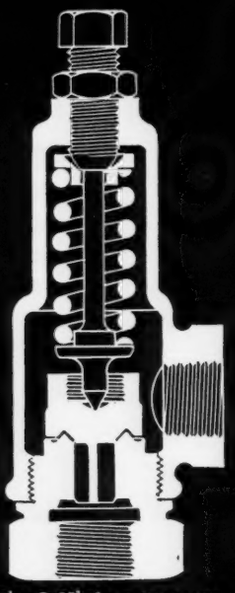


Fig.2-High-pressure relief valve

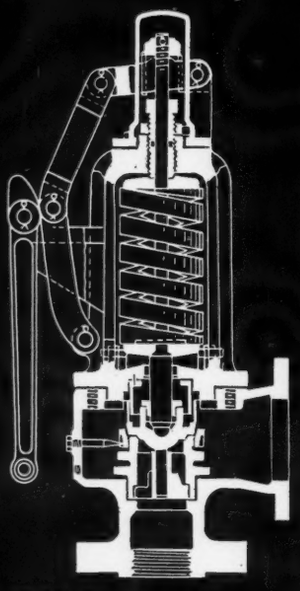


Fig.5-High-pressure safety valve, huddling-chamber type

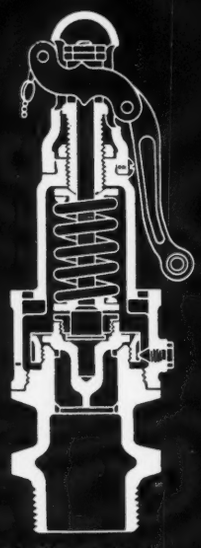


Fig.6-Top-outlet inside-spring valve

Fig.3-Huddling chamber principle

Fig.4-Reaction effect principle

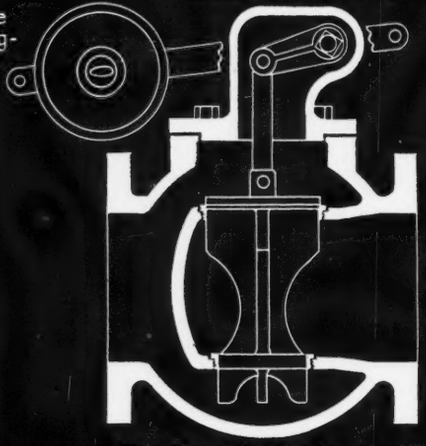


Fig.9-Weighted-lever semi-balanced valve

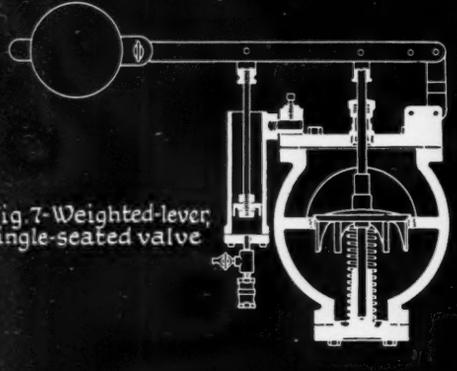


Fig.7-Weighted-lever, single-seated valve

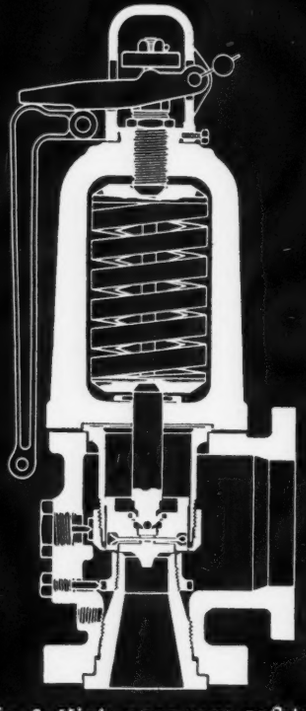


Fig.8-High-pressure safety valve, reaction type

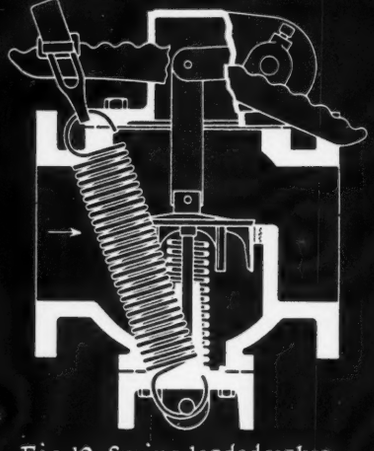


Fig.10-Spring-loaded valve

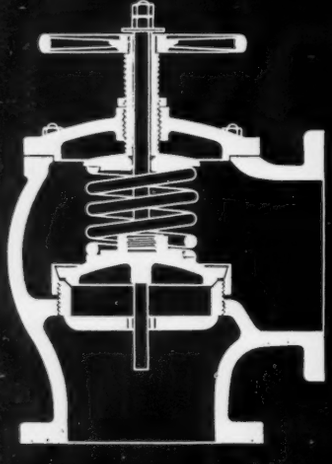


Fig.11-Inside-spring valve

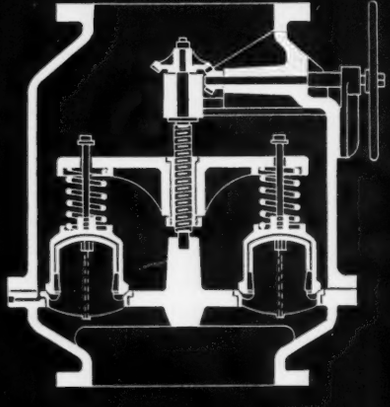


Fig.12-Multiport valve

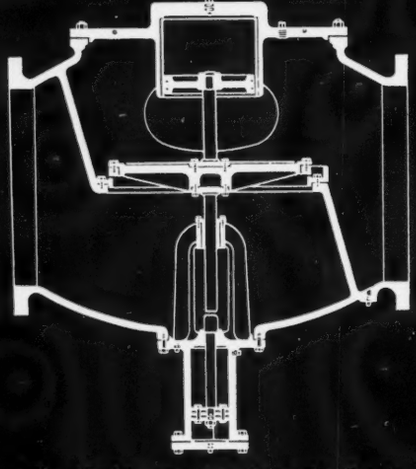


Fig.13-Atmospheric-relief valve

RELIEF VALVES

THE FIRST and simplest form of relief valve has a weight at the end of a lever holding a flat disk against the valve seat. Adjustment is made by moving the weight along the lever. Because of ease of tampering, most State codes restrict its use, and even where permitted it is too cumbersome for high-pressure and high-capacity work. In its particular place, it offers advantages of cheapness, simplicity and ruggedness.

Spring-loading is almost universally employed on modern relief valves. Essential elements are a calibrated spring holding the disk on its seat against system pressure. The simplest type, now largely outmoded, has a disk only slightly larger than the seat, consequently the only lifting force is pressure on the disk area. Low lift and discharge capacities characterize this type. Extending disk area increases lift and capacity. Pressure acts on an area equal to seat-ring internal diameter first, but when the disk lifts off its seat, additional area is exposed and the resulting increased force accelerates the lifting action.

Fig. 1 is a typical relief valve for low-pressure low-temperature service. The disk is guided from below, and its extended area can be seen. For handling water and non-corrosive fluids, it is customary to mount the spring inside the valve body. Fig. 2 is a relief valve for severe hydraulic service, up to about 16,000 lb.

Safety Valves

Relief valves for steam service are usually called safety valves. When disk area is extended to give additional lifting speed, the quick opening effected has led to the designation "pop" valve. Safety valves may be obtained with top or side outlets, inside or outside springs, flat or conical disks, and with bottom or top disk guides. Two general principles of increasing lift are in vogue, the "huddling chamber" and the "reaction". Referring to Fig. 3, the huddling-chamber system employs either a flat-seating disk, as shown, or a conical disk. As the disk unseats, steam rushes into the chamber formed by the adjusting ring and the extension of the disk. Pressure on the added disk area is made more effective by being confined and directed. Reaction disks are usually flat-seating, as shown in Fig. 4. When the valve unseats, steam at high velocity, due to the nozzle-shaped passage leading to the seat, hits the extended surface of the disk, is deflected by the adjusting ring, and the resulting reversal of direction produces a reaction force in the direction of disk travel.

Rapid lift saves steam and increases safety by permitting the valve to operate at very slight overpressures and to close at similarly slight underpressures.

Capacity of safety valves may be determined by formulas for flow through orifices. With the disk in the open position, the annular space between it and the seat constitutes an orifice. If the disk is lifted high enough, nozzle area within the seat ring will limit flow. The ASME Code for Power Boilers requires that rated capacity of the valve must be met at an overpressure of not more than 3% of set pressure, with a blowdown of not more than 4% of set pressure. Recent tests and experience have shown that coefficients used in orifice formulas must be checked by actual test with a given design to allow for differences in design details. Superheat reduces the capacity of a valve. Most ratings are based on saturated steam, but correction factors are usually furnished to give actual discharge capacity for any given pressure and degree of superheat.

A typical low-pressure safety valve, Fig. 6, is of the top-outlet, inside-spring type and employs the huddling-chamber principle with a conical disk. The "blowback" ring may be adjusted from outside without dismantling. A lever is provided to unseat the valve for test purposes.

HP Safety Valves

Outside spring construction, with a yoke, is almost universal for high-pressure service, as higher temperatures are detrimental to the accuracy and life of the spring. A safety valve for 1,500-lb, 1,000-F service is illustrated in Fig. 5. Seating is conical, and the huddling-chamber principle gives the quick lift needed. Both this valve and the one just mentioned have bottom-guided disks. A valve for similar service conditions and featured by a reaction-lift disk, is shown in Fig. 8. The shape of the nozzle and the lower face of the disk are designed to give high velocity. The disk is top guided and spring pressure is transmitted by means of a hardened-steel ball resting on a hardened-steel cup.

Spring tension is affected by temperature, so where safety valves are subject to high temperature, such as in superheater service, a cooling spool may be provided between body and bonnet. Fins dissipate heat rapidly and the spring is separated from the hotter body.

When engines and turbines are operated non-condensing, a form of relief valve known as backpressure valve is installed to maintain desired exhaust pressure. Atmospheric relief valves, similar in construction to backpressure valves, open when the vacuum in a condensing plant is lost and backpressure rises slightly above atmospheric.

Backpressure Valves

Weight-loaded backpressure valves are simple and rugged in construction. A single seated, unbalanced type with outside dashpot is shown in Fig. 7. Where higher pressures must be maintained, the balanced or semi-balanced type of valve is better, because less weight is required to hold the valve on the seat. The semi-balanced weight-lever valve of Fig. 9 has a double-ported disk, the top member being bevel-seated and the lower member parallel-seated.

Spring-loaded valves are more compact and are widely applied in current practice. The single-seated spring-loaded valve, Fig. 10, is typical of this class. Spring tension may be varied by moving the top end of the spring along the notched lever, which transmits the force to the disk through the linkage. An inside-spring valve of compact design is also shown, Fig. 11. Multiported valves, Fig. 12, comprise two or more outlets, closed by disks under individual spring pressure. A bearing plate equalizes spring pressures and permits adjustment of all springs simultaneously. Greater port area makes for lower steam velocities and less wear. Multiplicity of disks reduces the possibility of troubles from sticking.

Atmospheric relief valves differ in two major respects from backpressure valves. They require far less pressure to operate, and they must seal tightly to prevent loss of vacuum. A globe type valve is shown in Fig. 13. Atmospheric pressure above the disk holds it seated until pressure below becomes slightly more than atmospheric. Areas and weights are adjusted so that only a slight differential is required for opening. Disk and seat are bronze, with a water seal. An internal dashpot piston above the seat prevents hammering. The hydraulic piston below serves to open the valve for testing or non-condensing operation. Rubber is sometimes used as a seating material to secure tightness without a water seal, but requires frequent replacement.

With adequate sealing and an adjustable weight or spring, a valve may be used either for backpressure or for atmospheric-relief service.

REGULATING VALVES

WITH appropriate control devices, valves of the regulating type may be applied in innumerable ways in power and process work. General principles are the same in all cases, however. The control element is designed to react to changes in pressure, temperature, rate of flow, liquid level, etc. If the nature of the control element is such that a strong impulse can be sent out, it may be linked to the valve directly; if not, a multiplying element is necessary. This is usually a pilot valve actuated by the control element. The pilot valve controls an external source of power which operates the main valve. Because they find wide application in the power field and illustrate most of the principles involved in control-valve design, let us consider here two types only, the float valve and the pressure-reducing valve.

Float Valves

The float valve is a device for maintaining a given water level. Variations change the position of a float linked mechanically to the stem of the regulating valve. In most cases the float is inside the tank, connected by a lever to a shaft which passes out through the side of the tank by means of suitable bearings and a stuffing box.

Provision for the shaft bearings and stuffing boxes required by an internal float may be made in the design of the tank, or a complete unit (float, lever, shaft, bearing, and stuffing box) may be obtained mounted on a flange, Fig. 1, to be bolted to a nozzle on the tank or directly to the side of the tank, if flat.

Float Boxes

In heaters, the interior of the shell is filled with tubes, so it may not be possible to use an internal float. Float boxes, Fig. 2, cast-iron chambers containing a float and shafting assembly, may be mounted on the shell in such a way that the centerline of the chamber is approximately at the control level, and connected to the tank by equalizing pipes so that the water level in both will be the same.

For sensitive and dependable action, the valve must be designed to operate on as little force as possible. Most common practice is to use a double-seated arrangement for balancing; pressure on the valve inlet acts upward on the upper disk and downward on the lower. By juggling the areas exposed and the weights of the parts, various degrees of balance can be obtained.

Several types of seating arrangements are used in valves of this kind. The valve referred to above has disks of the plug type. Another valve, Fig. 3, is of the so-called seatless construction, the disk sliding in sleeve-type seat rings. Note the dashpot arrangement at the top for cushioning against shock or water hammer. Many forms of ported disk are used; the double-ported type, Fig. 4, gives a quick opening action. Where throttling is desired in the early stages of opening or closing, the ports are frequently "V" shaped, Fig. 5.

Another type of balancing is effected by an internal pilot valve. In Fig. 7, inlet pressure acts downward on the piston until the pilot valve is opened by the first slight motion of the float. Opening the pilot valve releases pressure on the piston through the central port and the valve is lifted by the inlet pressure. Lifting of the float acts to close the pilot valve, and initial pressure accumulating above the piston then will close the main valve.

Reducing Valves

Reducing valves are designed to take a constant or fluctuating inlet pressure and automatically reduce it to some predetermined constant pressure.

Direct-actuated reducing valves are simple in construction and will give good control but are limited in their application to low delivery pressures and low capacity. Most direct-acting valves are diaphragm-actuated, with spring loading. Fig. 8 has a diaphragm acted upon by a calibrated spring. The reduced pressure is admitted at the top. Disks are of the double-ported type and are practically balanced. Changes in pressure on the downstream side affect the balance at the diaphragm and actuate the valve controlling the flow of high-pressure steam. Spring loading is more compact but is not constant throughout the travel. Weight loading is more accurate but is, of course, limited in practical application. In the valve of Fig. 9, the weight balances line pressure acting on the other side of the diaphragm. Occasionally a piston is employed in place of a diaphragm, particularly for high-pressure service. Fig. 6 is a reducing valve of a new type with a stainless-steel ball as the disk. Motion of the ball is controlled by a shaft actuated by a diaphragm in the chamber at the bottom. The diaphragm is balanced by the reduced pressure from the downstream side of the line, and by the pressure of a fluid column acting from below through the pipe shown. The liquid may be water or mercury, as preferred. Similar valves, with minor modifications of construction, are equipped for spring or weight loading.

For dead-end service, that is when it is required to maintain a reduced pressure during periods of no flow on the reduced side, a valve that closes tightly is necessary. For such service a single-seated valve, Fig. 10, is usually employed.

Pilot-Type Valves

Greater flexibility of application and adaptability to high-pressure, high-capacity service characterize the pilot-valve operated type. In the relatively simple valve of Fig. 11, pressure from the downstream side is balanced against spring loading in the small compartment at the top. Pressure differences open or close the pilot valve which controls the admission of steam at inlet pressure to the large piston at the bottom, which actuates the main valve. In the slightly different construction of Fig. 12, seating of the pilot valve closes an exhaust port and permits steam at high pressure to accumulate behind the main diaphragm, acting to close the main valve against a loading spring.

Operation from remote regulators is common, especially in large high-pressure installations. A turbine-type valve, Fig. 13, has a hydraulic cylinder mounted integrally. Seating surfaces and the disk have been designed to form an opening similar in section to the throat of a steam-turbine nozzle, to reduce erosive action. Disks and stem are forged and machined from a single piece of stainless steel. In the normal installation, the regulator, of the diaphragm type, is an independent unit, as is the pilot valve, which controls flow of oil under pressure to the hydraulic cylinder shown at the bottom of the valve.

A balanced venturi-type valve, Fig. 14, has motion of the stem transmitted mechanically from a hydraulic regulator. The valve body is proportioned to produce smooth flow with a venturi section on the outlet side for correct expansion. Long travel of the tapered disk gives close regulation. A similar connection to a hydraulic regulator may be used with the butterfly-venturi valve, Fig. 15.

By combining diaphragm or piston-actuated valves with pilot valves or controllers of various kinds, almost any control function can be handled. A typical, diaphragm-actuated, spring-loaded, "V"-ported control valve is illustrated in Fig. 16.

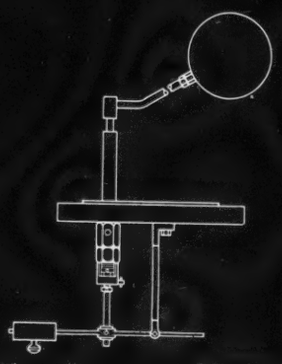


Fig.1-Flange-mounted float unit

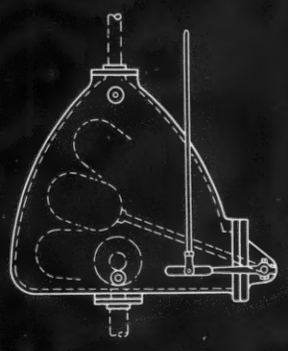


Fig.2-Float box

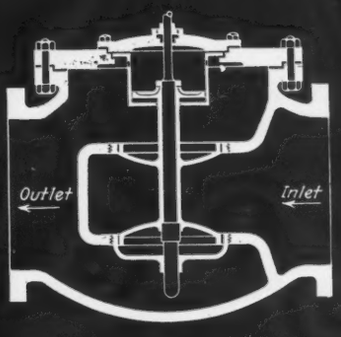


Fig.3-Seatless balanced

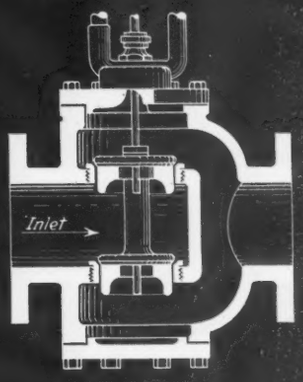


Fig.4-Double ported

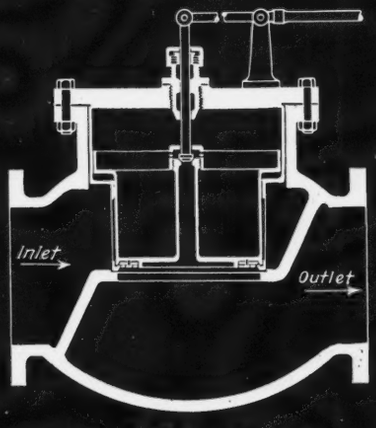


Fig.7-Pilot-valve type

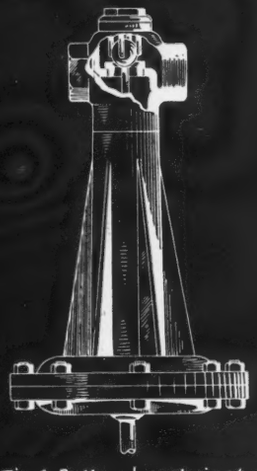


Fig.6-Ball-and-seat-ring type

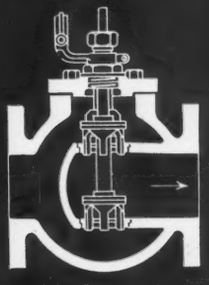


Fig.5-"V" ported

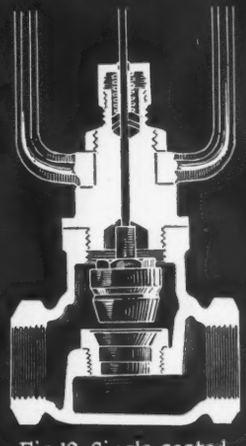


Fig.10-Single seated

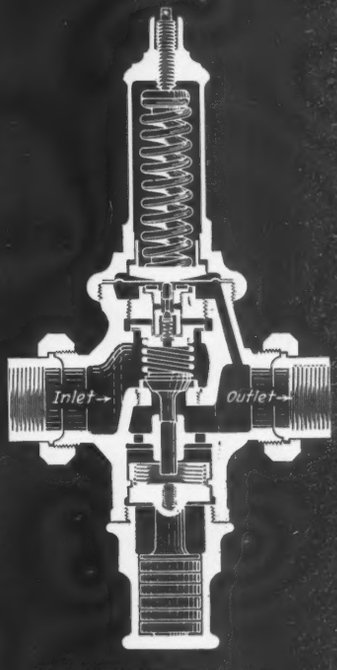


Fig.11-Pilot-type, piston actuated

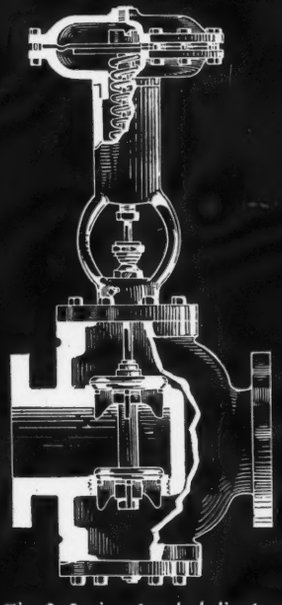


Fig.8-Spring-loaded diaphragm

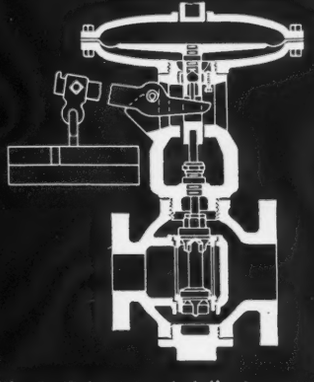


Fig.9-Weight-loaded diaphragm

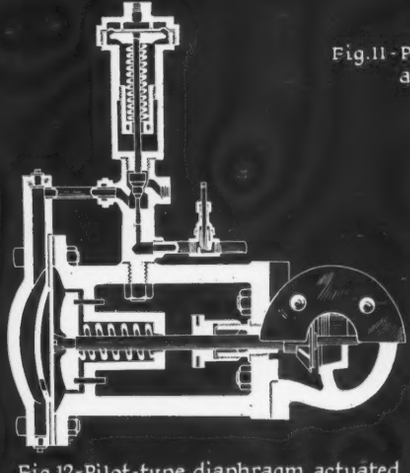


Fig.12-Pilot-type, diaphragm actuated

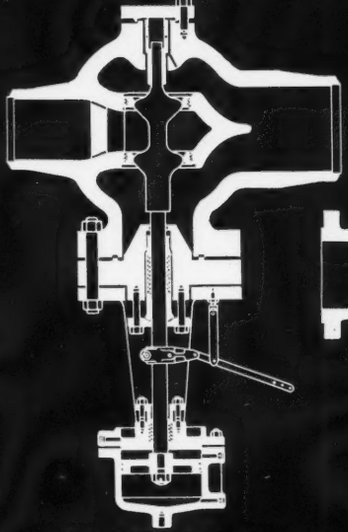


Fig.13-Turbine type

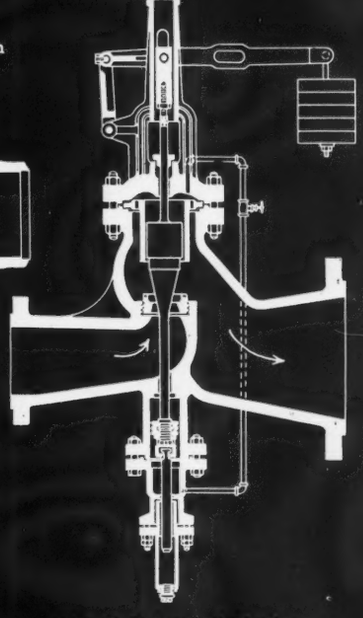


Fig.14-Balanced Venturi

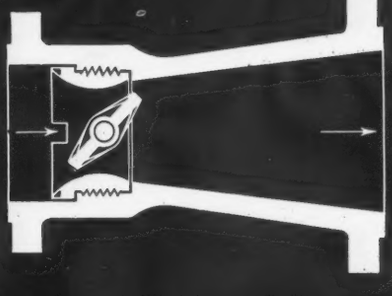


Fig.15-Butterfly Venturi

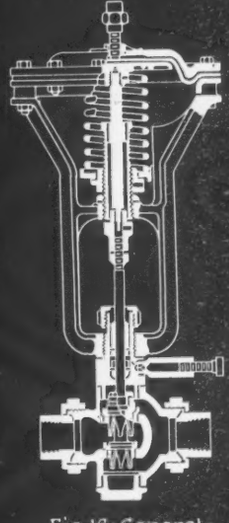


Fig.16-General-purpose control

Fig.1-Bimetallic thermostatic

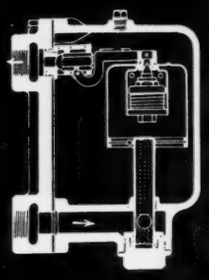


Fig.2-Inverted bucket-thermostatic vent

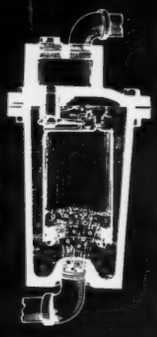


Fig.3-Inverted bucket

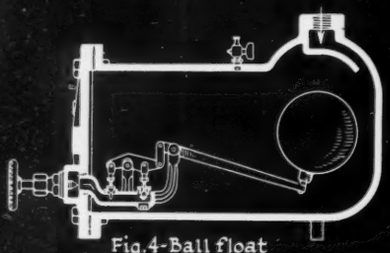


Fig.4-Ball float

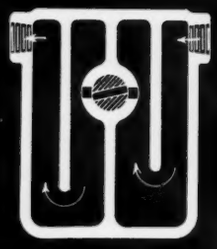


Fig.5-Orifice with baffles

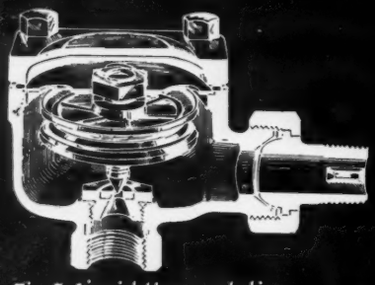


Fig.7-Liquid thermostatic

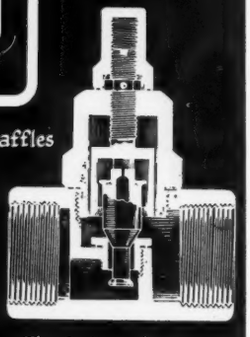


Fig.6-Impulse

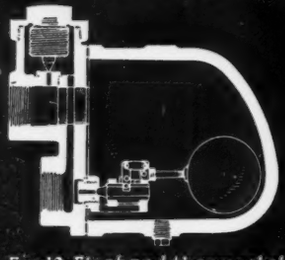


Fig.10-Float and thermostatic

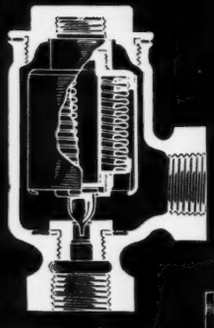


Fig.8-Vapor thermostatic

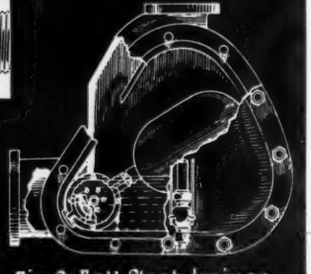


Fig.9-Ball-float drainer

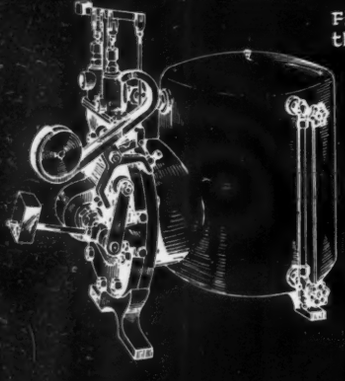


Fig.11-Non-tilting return

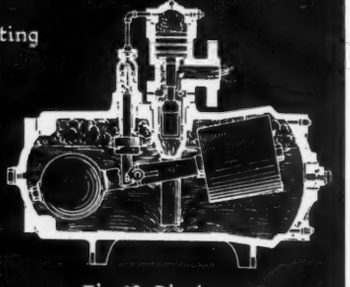


Fig.12-Discharger

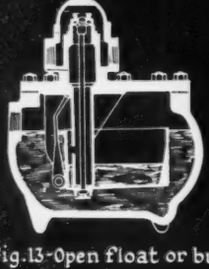


Fig.13-Open float or bucket

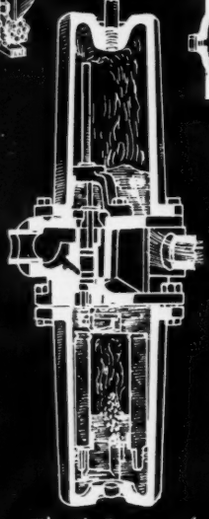


Fig.14-Compound

Fig.15-Tilting

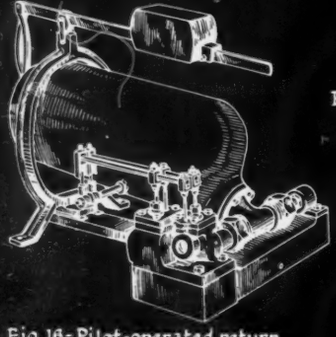


Fig.16-Pilot-operated return

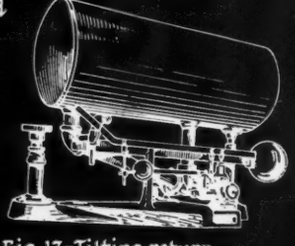


Fig.17-Tilting return

TRAPS

A TRAP IS an automatic valve which retains valuable fluids or gas while passing waste products. The most common application is in steam systems, where they remove condensation, formed as a normal part of the process (heating apparatus) or as an unavoidable loss (piping, prime movers), without loss of steam. This prevents damage from slugs of water and improves heat transfer and circulation. Some types also remove air, because its presence hinders circulation and dilutes steam. Traps are also used to drain water from compressed-air and gas lines, and occasionally to remove water and oil or grease from separators.

Types of Traps

Non-return traps separate only, discharging at a pressure lower than the inlet pressure. Return traps lift or pump, discharging at a pressure equal to or greater than the inlet pressure. Let's look at non-return traps first.

Open-float or **bucket** traps discharge intermittently. Condensate fills the trap around the floating bucket until it overflows and sinks. This opens the discharge valve, the bucket and valves being linked in various ways in different makes of traps. Inlet pressure drives the condensate out, restoring bucket buoyancy. The valve closes and the cycle repeats.

Inverted bucket traps work on a different principle. As long as condensate fills the body and bucket, the valve remains open and the trap discharges. Steam is caught in the upper part of the bucket, gradually increasing the buoyancy until the bucket rises and closes the valve. Additional water now displaces the steam and reduces the buoyancy, allowing opening of the valve. Most traps of this type contain provision for venting air. In one case, air rising through the bucket passes out through a small hole into the top of the trap. Accumulated air leaves ahead of the condensate when the valve opens. In another, a thermostatic valve regulates air flow to times when no steam is present, thus conserving heat.

Tilting traps employ a pivoted bowl or tank as the control medium. Condensate enters the bowl through trunnions and gradually overcomes the effect of a counterbalancing weight, causing the tank to sink. The tank is linked to a discharge valve so that sinking causes the valve to open and the trap discharges under inlet pressure.

Ball float traps differ in that discharge is normally continuous rather than intermittent. The amount of opening of the discharge valve is controlled by the position of a float and consequently by the level of condensate in the trap shell. Increased capacity for given inlet and outlet conditions results, but wiredrawing is likely to occur at partial valve openings, accelerating erosion of the disk and seat.

Orifice traps have many variations in practice, but the general principle is to provide a small orifice or restricted passage which will pass a trickle of condensate but obstruct steam flow.

Impulse traps are a recent development of experiments showing that the pressure in the space between two orifices in series varies with the temperature of the fluid flowing. The impulse trap consists of a body not unlike that of the globe valve, with a loosely-fitted control valve, as shown in the sketch. The space between the valve and the control chamber wall constitutes the first orifice and the second orifice is drilled through the valve disk. Pressure in the control chamber will vary according to the temperature of the fluid entering the trap. Motion of the valve is the resultant of the intermediate pressure, the inlet pressure under the disk, and the weight of the valve. Low-temperature condensate produces low pressure in the control chamber, and the valve rises, passing condensate. Hot condensate or steam creates high pressure in the control chamber and acts to close the valve. The temperature at which the valve will operate is controlled by the sizes of the two orifices and the relative sizes of the valve disk and seat.

Thermostatic traps depend for their action on expansion due to temperature changes. The simplest is the bimetallic, in which the different rates of expansion of two dissimilar metals operate the discharge valve. In the trap illustrated, steam or hot condensate expands the inner tube to a greater degree than the outer, which keeps the valve shut. Cooling of the condensate opens the valve.

Another type of thermostatic trap depends on expansion of a liquid-filled element for operation. A typical trap, illustrated, contains a diaphragm assembly carefully sealed to hold the highly expansive liquid under all operating conditions.

Still a third type of thermostatic trap depends on vaporization of a volatile liquid sealed in a flexible bellows. Steam or heated condensate causes vaporization and consequent expansion which holds the valve closed. Cooling produces condensation of the vapor, and tension in the bellows raises the valve from its seat.

It is important to note that the bucket and float traps operate to remove condensate when a given quantity has been formed regardless of temperature, but that the impulse and the thermostatic traps discharge only when the condensate has reached a certain temperature. These characteristic differences make each general type of trap particularly suitable for specific kinds of installations.

Float and thermostatic traps combine continuous discharge at high capacity of the ball-float type with the controlled venting characteristic of the thermostatic trap.

High-Capacity Traps

For draining large extraction heaters and other equipment producing large quantities of condensate which must be removed efficiently, several types of high-capacity traps are used.

The continuous discharge characteristic of the ball-float trap makes it particularly adaptable for this work. In the drainer illustrated, the ball-float mechanism operates a balanced rotary valve with several large ports.

Various types of dischargers have been developed which utilize a pilot valve to actuate a larger valve than could be operated directly from the control mechanism. Two are illustrated. In one, the motion of a displacement beam actuates the pilot valve which admits steam to a piston on the main valve stem. The steam forces the piston down, opening the large main valve and permitting discharge until the motion of the displacement beam closes the pilot valve. The other employs an inverted bucket to control the pilot valve. Steam and water reach the bucket through a pilot tube extending from near the top of the upper or receiving chamber. Heavy flow of condensate fills the receiving chamber and cuts off the top of the pilot tube, preventing steam from entering the inverted bucket. Water flows down the tube, the level under the bucket rises and the bucket sinks. This causes the valve to open and the pilot trap to discharge against the head of the piston. The multiplying effect of the difference in area between the piston head and the piston valve causes the piston to rise, opening the main discharge valve. Lowering of water level in the upper chamber unseals the pilot tube and, as condensate is drained out, steam can flow down under the inverted bucket, restoring its buoyancy and closing the pilot valve.

Return or Lift Traps

Return traps are commonly used for feeding condensate to the boiler, but may be applied in any case where a lifting operation beyond the capacity of a separating trap is required.

All return traps have a tank or receiver into which the condensate flows either by gravity or by the lift of another trap or traps. When a predetermined level is reached, the flow of condensate is shut off, the receiver vent is closed, and steam at boiler pressure is admitted to the tank, forcing condensate out the discharge opening. As the receiver empties, the process is reversed. A check valve prevents backflow through the discharge opening, the tank vent is opened and condensate again flows into the receiver. When used for boiler feeding, the trap is always installed several feet above the drum, so that when steam is admitted to the trap tank, pressure between receiver and the boiler is equalized and water flows into the drum by gravity.

Several advantages are claimed for return traps, namely that heat is saved by keeping the condensate at a higher pressure and temperature than would be the case with an open hotwell, practically no steam cost for pumping, and simplicity of construction and operation. Disadvantages are unsuitability for high-capacity boiler feeding, and control based on amount of condensate returned rather than level in drum.

In the tilting return trap, the tank or receiver is pivoted on trunnions and counterbalanced by a weight on a lever. As the tank fills, its weight overcomes the balance weight and the sinking of the tank actuates the valve mechanism. Various mechanical arrangements operate the valves, and at least one has a pilot valve to control a steam-actuated main valve.

The non-tilting type represents an adaptation of the ball-float trap with a device to multiply the force of the float lever. A trap of this type is illustrated. The float lever moves the rack with the weight into a horizontal position and slightly beyond, causing the weight to roll and snap the rack to the opposite position, thus actuating the valves. Motion of the float in the opposite direction reverses the cycle.

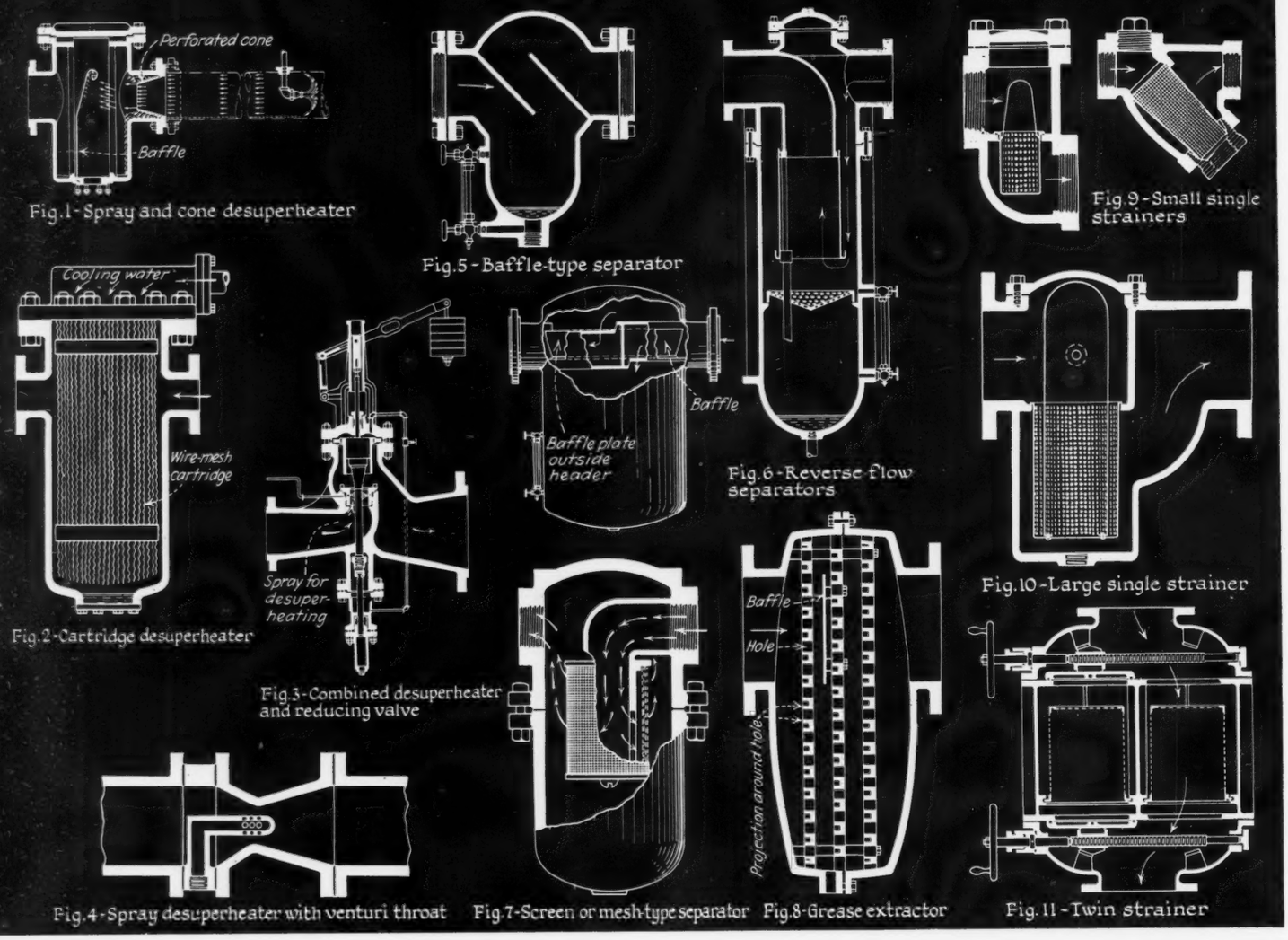


Fig.1-Spray and cone desuperheater

Fig.2-Cartridge desuperheater

Fig.3-Combined desuperheater and reducing valve

Fig.4-Spray desuperheater with venturi throat

Fig.5-Baffle-type separator

Fig.6-Reverse flow separators

Fig.7-Screen or mesh-type separator

Fig.8-Grease extractor

Fig.9-Small single strainers

Fig.10-Large single strainer

Fig.11-Twin strainer

DESUPERHEATERS AND SPECIALTIES

DESUPERHEATERS, custom-made for "tops," standardized for small plants and process, reduce steam temperature when pressures must be reduced to serve process or to connect two parts of a plant operating at different pressures. Most common is the spray-type, in which a fine water stream strikes the steam path. Simple, easy to control, it usually requires removal of entrained moisture.

Fig. 1 shows a desuperheater with spray nozzle downstream and a cone-shaped mesh to remove moisture. A baffle assist in this. Fig. 4 is a type used on several large superposed units. Its spray nozzle is at the venturi throat to utilize highest steam velocity. Water swept off the nozzle in thin sheets is carried to the stream center, where it breaks into a readily evaporated mist. Complete evaporation avoids the need for a separator.

The cartridge type, Fig. 2, interposes a water film in the rapidly moving steam. Water from nozzles at the top trickles down through the cartridge, composed of woven wire compacted within a frame, and steam passes through the small mesh. Water droplets mix intimately with steam, cooling being accomplished partly by direct contact, partly by alternate heating and cooling of the mesh. Water is not normally carried along with the steam. Tubular desuperheaters have also been used, but require larger heating surface and more water, so are not as efficient.

Recently, desuperheater and reducing valve have been combined, Fig. 3. Spray nozzles supply cooling effect at the point of highest velocity. Thorough mixing avoids a separator.

Separators remove impurities from steam, particularly entrained moisture, dangerous to many steam-using units. One type, Fig. 5, causes the steam to pass a baffle; another, Fig. 6, causes a sharp change of direction in the steam path; still another, Fig. 7, combines these actions. Change of direction throws out denser impurities; baffles or mesh cause them to adhere. Note that all these units have large storage space to catch removed impurities and to absorb steam-flow fluctuations. Most separators also remove oil and grease from exhaust steam, but some have extra surfaces for impingement, like Fig. 8, and are called grease extractors. Many modern boilers have steam separators or washers built in the drum.

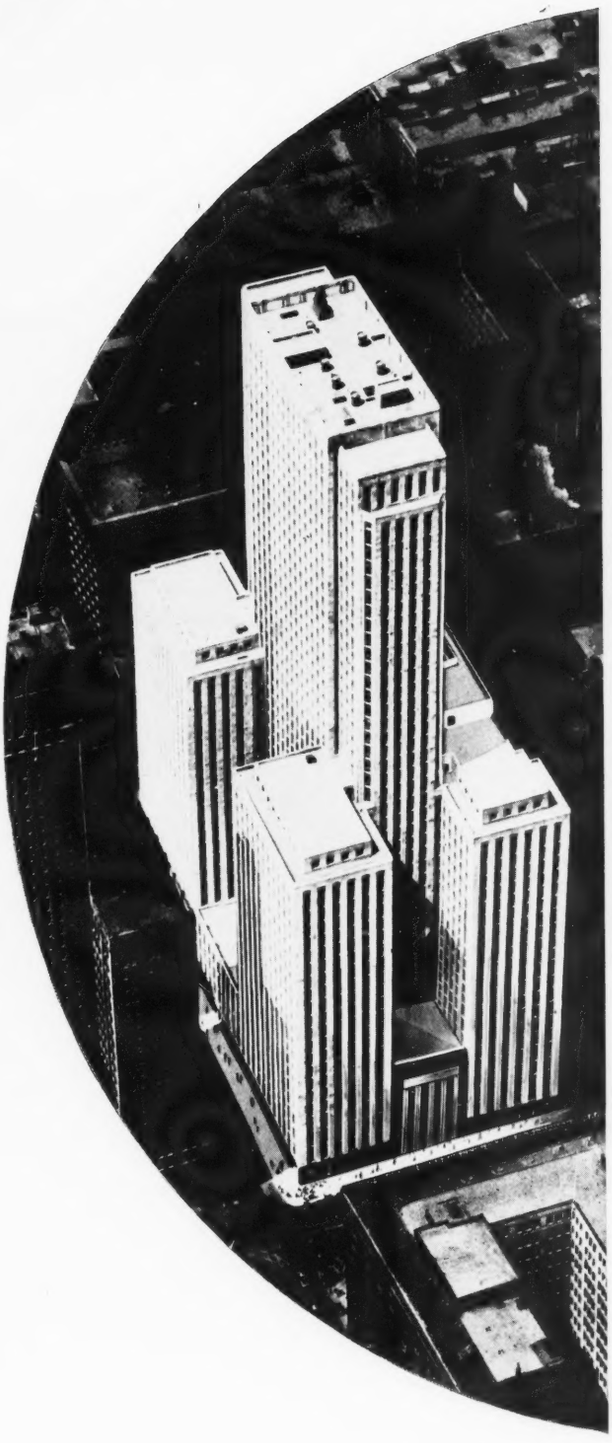
The strainer is a simple, but often forgotten, element. It will remove silt, metal particles, grit and foreign matter from fluids before they have a chance to damage impellers, valve seats, traps, and instruments. The single strainer, Figs. 9 and 10, is compact, cheap, and suitable where service interruptions for cleaning cause no trouble. Its body casting contains a removable perforated-metal or wire-mesh basket. Basket size must be large to avoid restriction of flow.

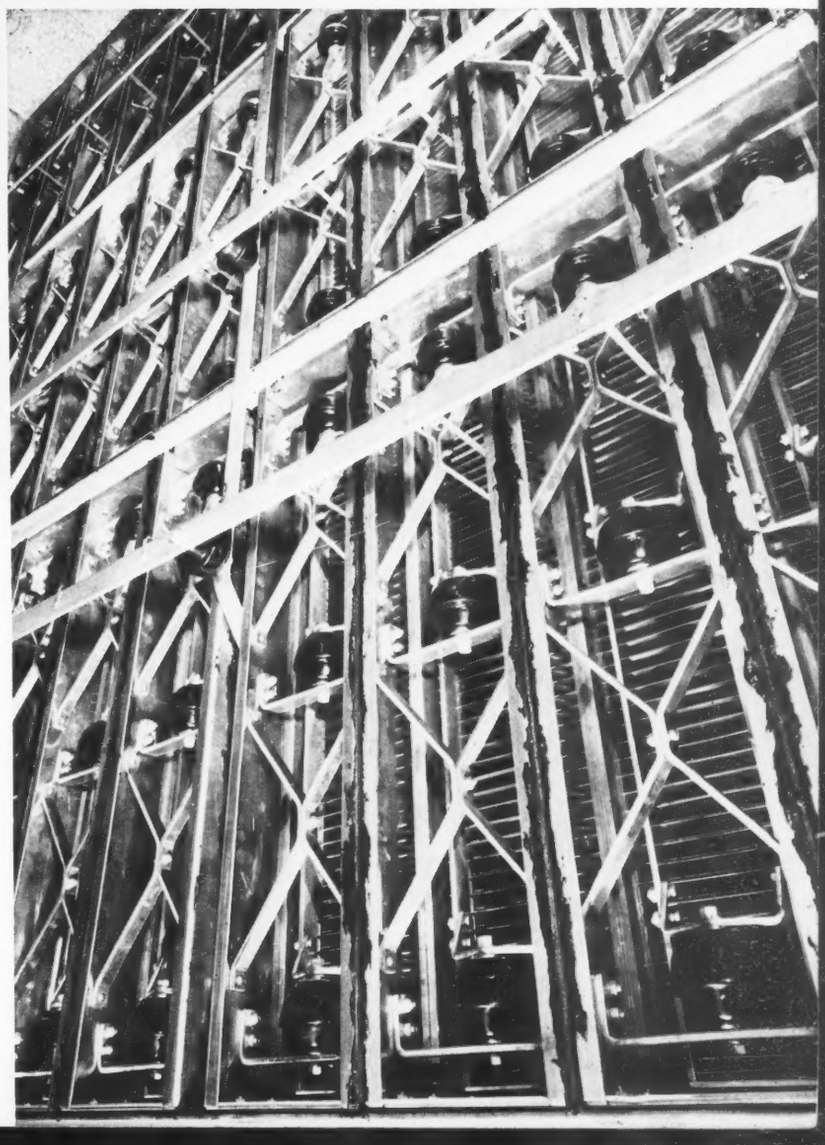
Under more severe conditions, when interruption of flow cannot be tolerated, the twin strainer, Fig. 11, is used.

Filters remove finely divided particles and impurities such as oil or grease. In construction they resemble the strainer, except that a specially woven cloth bag replaces the metal basket. They may be single or twin.

SUPERCLEAN AIR

By charging all particles in the air electrically and pulling them out as they pass through an electrostatic field, up to 99%, by weight, of foreign matter is removed





Upper left—The first 4 floors and lower arcade of the new Field Bldg, Chicago's tallest, are supplied with clean air by Westinghouse electrostatic air cleaners. Upper right—General view showing 3 electrostatic air cleaners, power packs and door switches. Right—Outlet side of 22,500-cfm air cleaner which is composed of thirty 750-cfm collection cells. The air is first bombarded with ions emitted by wires as fine as human hair carrying 12,000 volts. Then the charged particles are passed through cells containing 5,000-volt high-potential plates. Charged particles adhere to the plates, and are cleaned off every month or six weeks

THE RECORD TELLS
of RILEY PROGRESS
in the BOILER INDUSTRY

Sales volume is a true indication of a company's progress within an industry. Sales volume depends upon a company's ability to furnish equipment which renders unusual satisfaction and outstanding performance.

You will note from the accompanying curves that Riley sales have increased almost three times as rapidly in recent years as sales of the total boiler industry, with Riley sales in 1937 at a rate of over three times 1929 sales . . . the boom year.

The tremendous increase in Riley sales volume indicates the very definite swing to Riley Boiler equipment. This swing to Riley reflects the progress made by Riley in boiler design and engineering with the resultant outstanding performance results of recent Riley Installations.

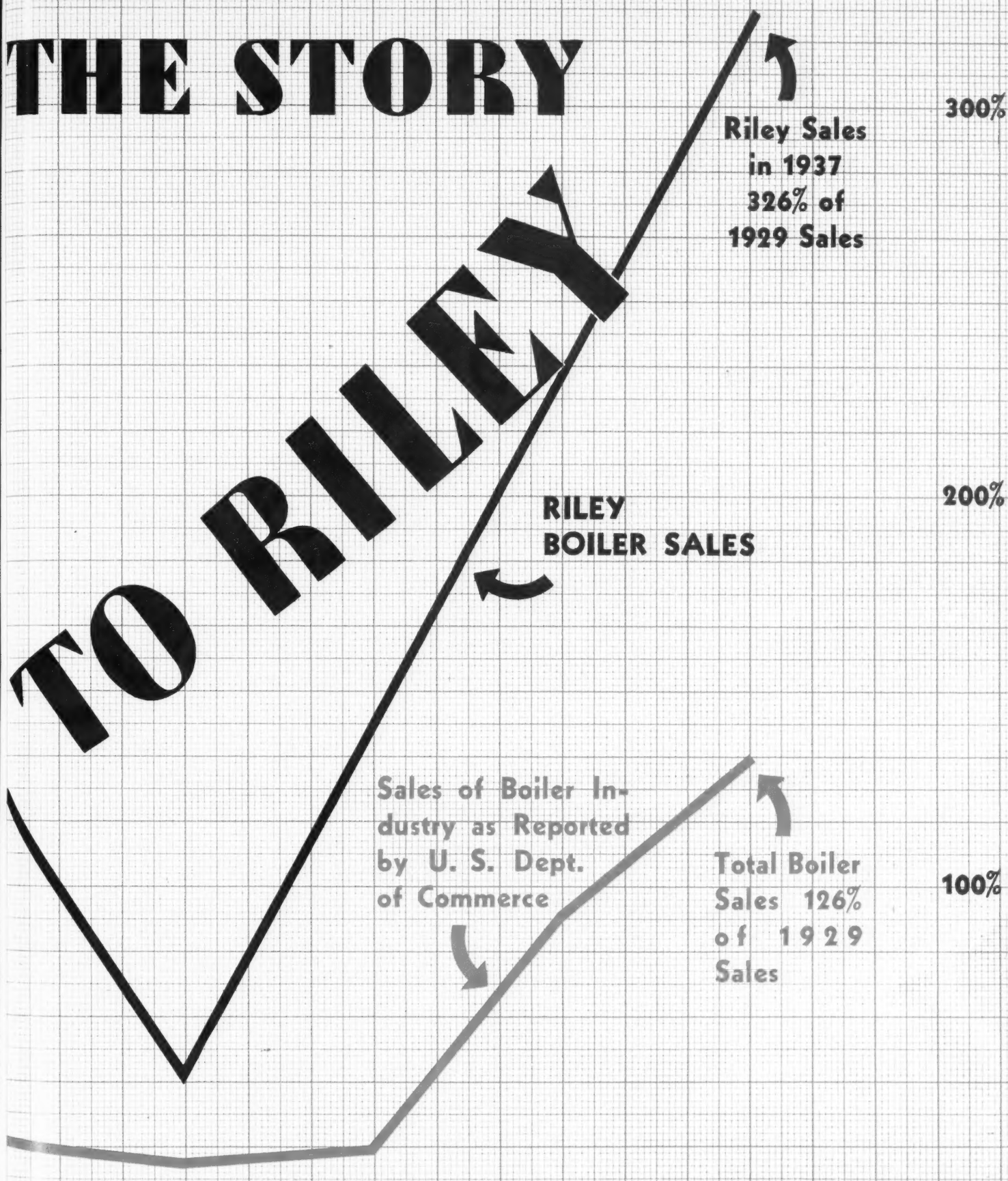
The Riley Stoker Corporation sincerely invites you to visit a number of recent Riley Installations. Such a visit will make perfectly clear to you the reasons for Riley's progress in the boiler industry. You will see modern highly efficient steam generating equipment and will come to appreciate the significant worth of the many plus values found in Riley equipment.

You owe it to yourself and your company to investigate Riley Boiler and Fuel Burning Equipment.

RILEY

STOKER CORPORATION WORCESTER, MASSACHUSETTS

THE STORY TO RILEY

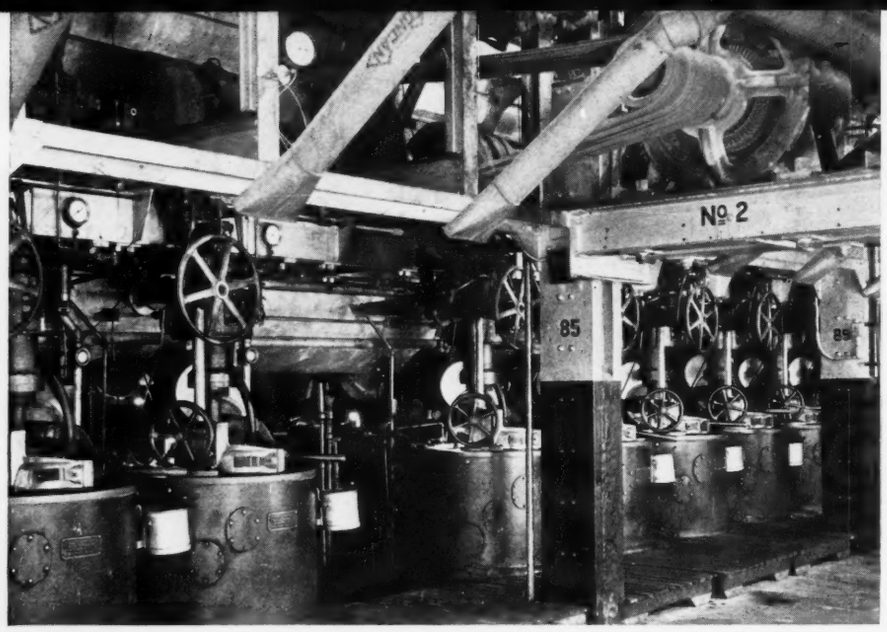


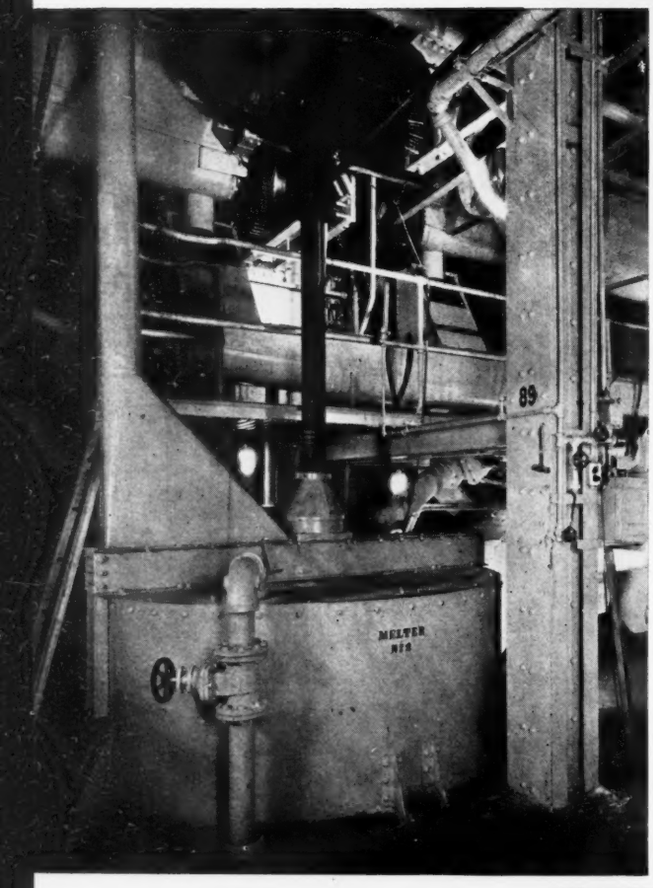
BOSTON NEW YORK PHILADELPHIA PITTSBURGH BUFFALO CLEVELAND DETROIT TACOMA BALTIMORE
ST. LOUIS CINCINNATI HOUSTON CHICAGO MILWAUKEE DENVER MEMPHIS ST. PAUL KANSAS CITY
LOS ANGELES ATLANTA NEW ORLEANS

COMPLETE STEAM GENERATING UNITS

BOILERS - SUPERHEATERS - AIR HEATERS - ECONOMIZERS - PULVERIZERS
BURNERS - STOKERS - WATER-COOLED FURNACES - STEEL CLAD SETTINGS

1. A 250-hp motor drives a line-shaft through V-belts, with reduction gears to high-speed centrifugals which whirl impurities from freshly received, partly refined sugar



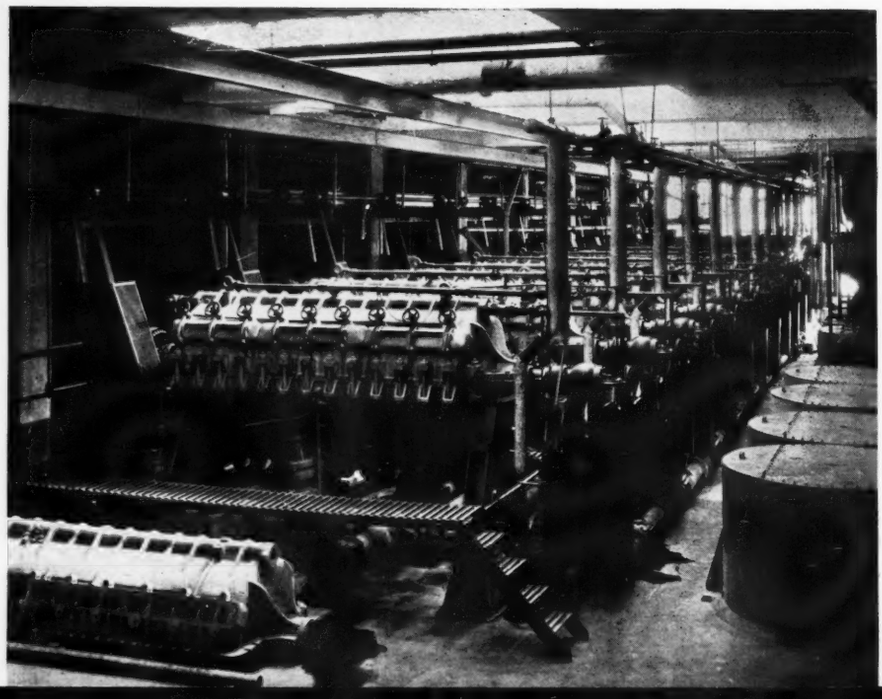


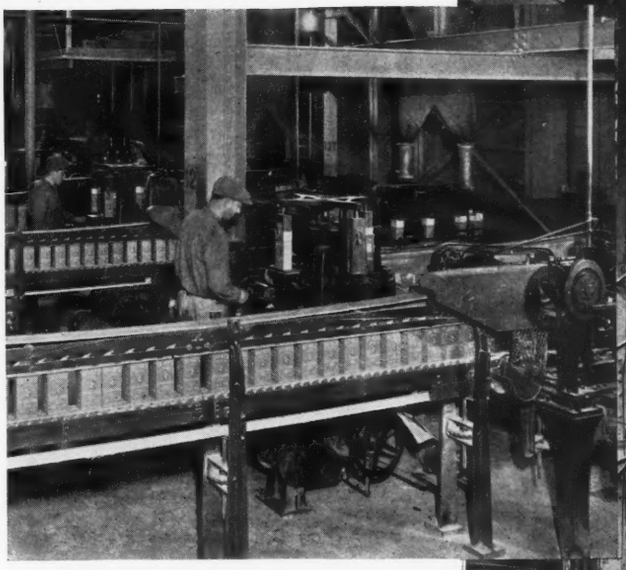
POWER SERVICES
Sweeten Your Coffee

Every day, sweet-toothed Americans consume more than 17,000 tons of sugar. Power services play a vital role in the transformation from raw sugar into the sparkling white crystals on your breakfast table. Here's how power enters the picture at Pennsylvania Sugar Co, Philadelphia

2. From the power plant comes steam to heat the sugar, and power for mechanical agitation and mixing with "sweet water" to produce a thick syrup

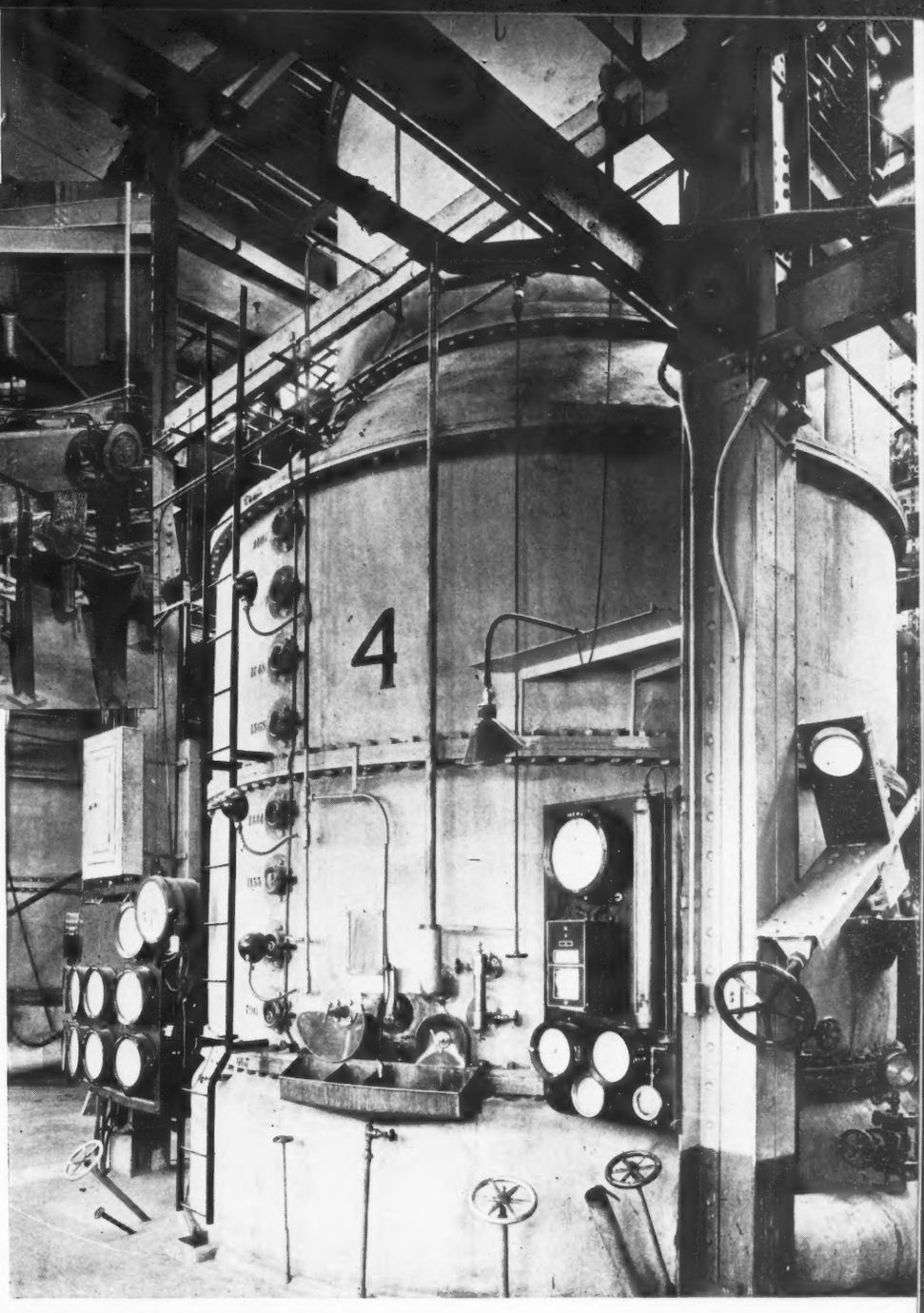
3. Powerful steam pumps force syrup through myriad tiny openings in the slowly rotating leaves of these mechanical filters. Additional clarification through bone char delivers a colorless fluid

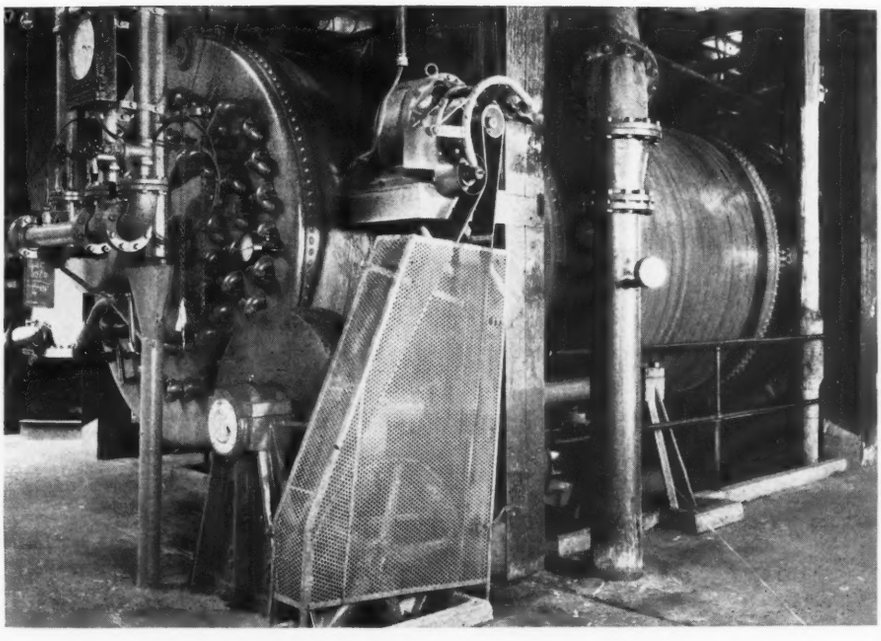




Packaging finished sugar

Packaged sugar is really packaged power—in the average plant more than 3 kwhr, 250 lb of steam, and 600 gal. of water are required in the processing of 100 lb of sugar

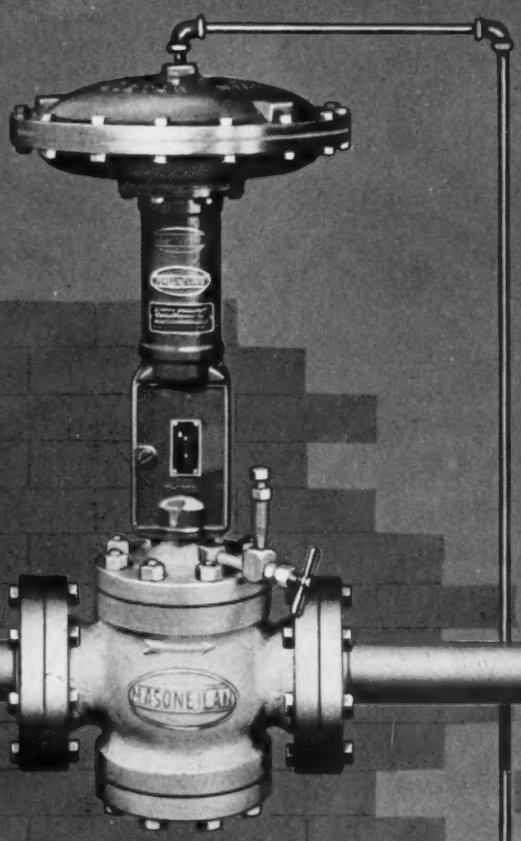




4. Steam again is needed to boil the sugar liquid, in vacuum pans to prevent scorching. Skillful manipulation produces crystals of the required sizes. Note the array of controls, instruments and the steam piping

5. More steam for heating, and more power, for rotating this crystallizer, are needed to dry the sugar after crystals have been separated from liquor in centrifugals

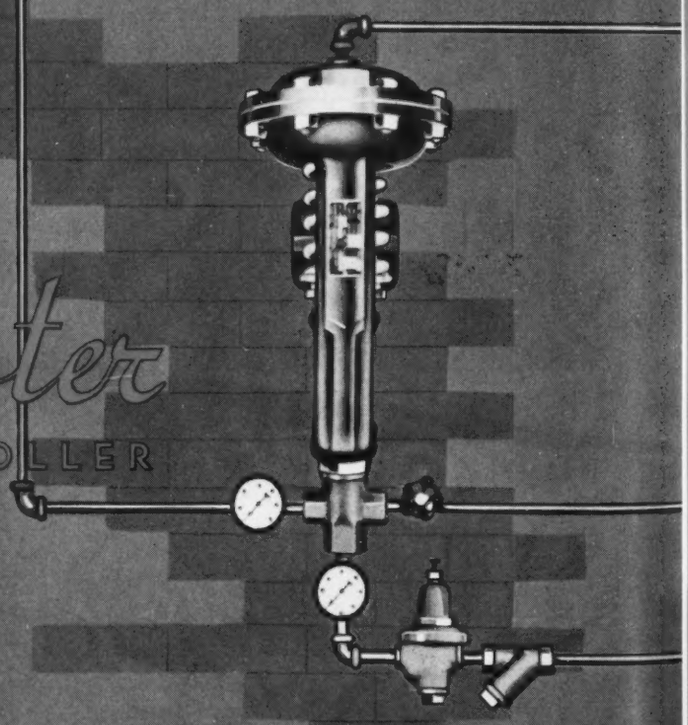
SIMPLIFIED



MASONEILAN

Syncromaster

PRESSURE CONTROLLER



PRESSURE CONTROL

THAT SAVES YOU MONEY

SIMPLICITY of design, construction, installation and operation are features of the hydraulic operated Syncromaster Pressure Controller. In spite of the use of highest quality materials and workmanship, therefore, pressure control with this equipment is less costly than with other less advanced types.

Because the Syncromaster Pressure Controller

is less expensive to buy—simplification means lower manufacturing costs, a saving passed on to you.

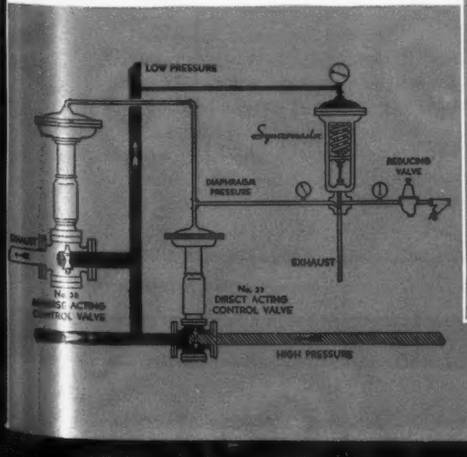
is less expensive to install—simplification eliminates all chains, weights, levers, complicated hook-ups, etc., permitting easy and quick installation.

is less expensive to operate—simplification permits operation from any external water supply of 20 to 150 lbs. pressure, with a *minimum* water consumption—the Syncromaster Pressure Controller bleeds only when control valve diaphragm pressure is reduced. Operation is fully automatic, sensitive and full throttling.

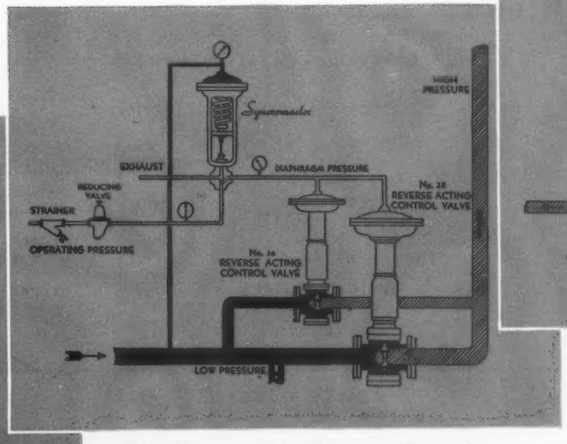
is less expensive to maintain—simplification reduces maintenance costs; rugged construction insures long life and trouble free service.

If your problem includes pressure control for primary or auxiliary steam lines, desuperheating service, pumps, make-up systems, heating and evaporating service or any service where accurate, positive control is required, investigate this simplified equipment.

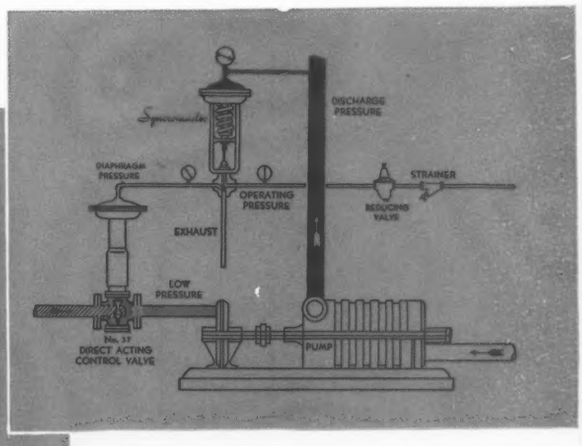
Write for Bulletin No. 50. Address Mason-Neilan Regulator Co., 1186 Adams St., Boston, Mass. Branch offices in New York, Philadelphia, Pittsburgh, Chicago, St. Louis, Tulsa, Houston and Los Angeles.



The Syncromaster Pressure Controller in supply and relief service on a make-up system.



The Syncromaster Pressure Controller in a make-up system with main and secondary supply valves.



The Syncromaster Pressure Controller regulating discharge pressure from a pump.

Number 64

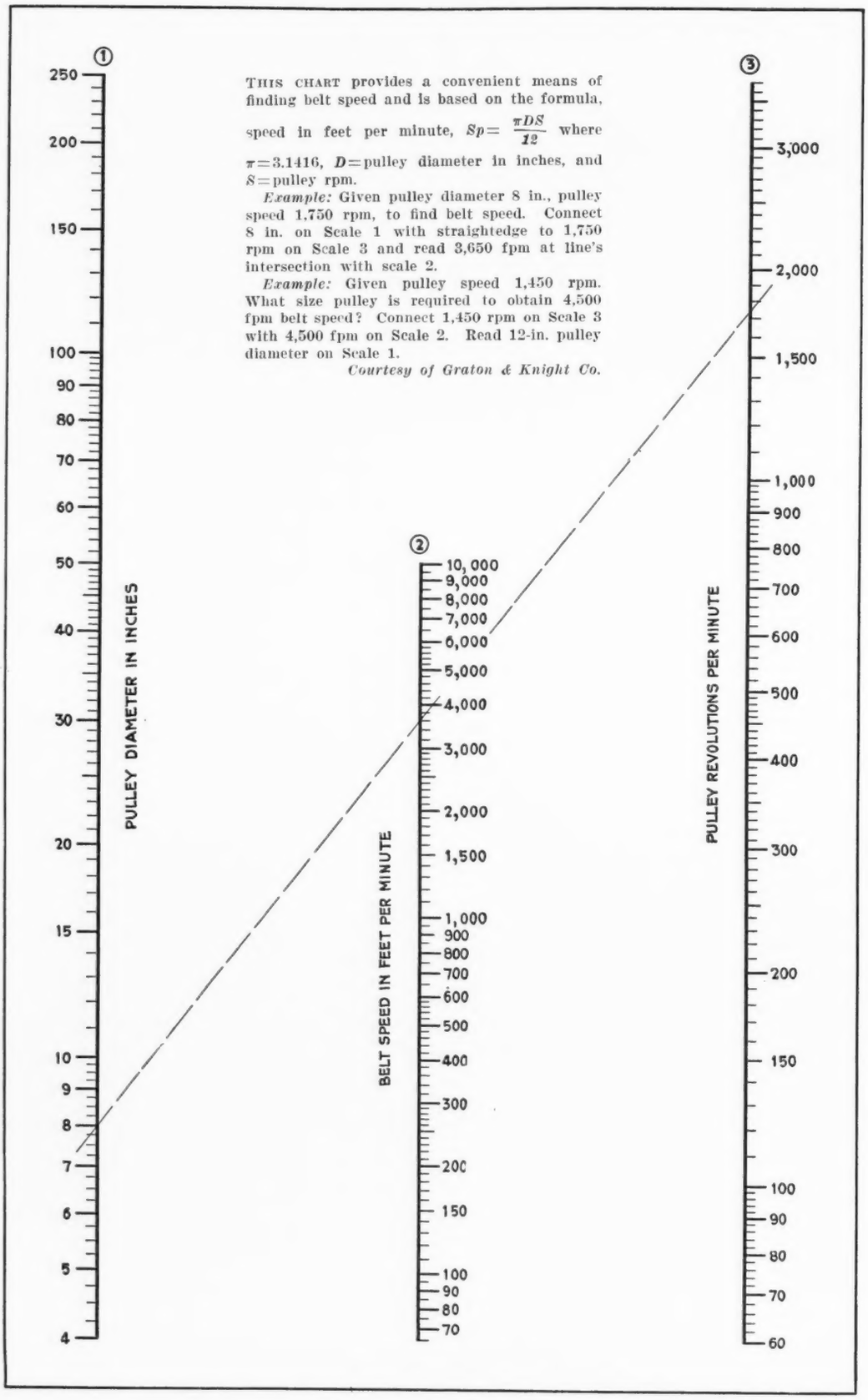
BELT SPEED CHART

THIS CHART provides a convenient means of finding belt speed and is based on the formula, speed in feet per minute, $Sp = \frac{\pi DS}{12}$ where $\pi = 3.1416$, D = pulley diameter in inches, and S = pulley rpm.

Example: Given pulley diameter 8 in., pulley speed 1,750 rpm, to find belt speed. Connect 8 in. on Scale 1 with straightedge to 1,750 rpm on Scale 3 and read 3,650 fpm at line's intersection with scale 2.

Example: Given pulley speed 1,450 rpm. What size pulley is required to obtain 4,500 fpm belt speed? Connect 1,450 rpm on Scale 3 with 4,500 fpm on Scale 2. Read 12-in. pulley diameter on Scale 1.

Courtesy of Graton & Knight Co.



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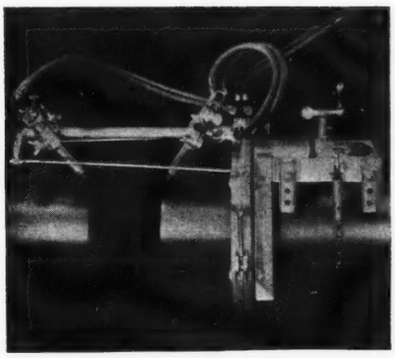
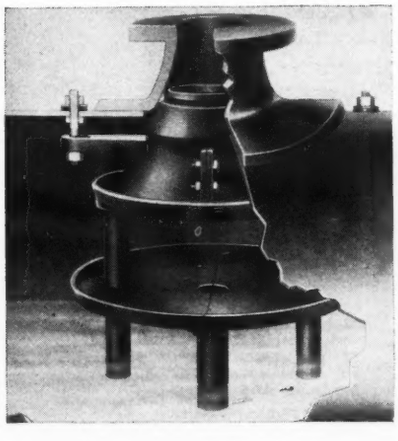
WHAT'S NEW IN PLANT EQUIPMENT



PIPE-CUTTING MACHINE

"OXWELD TYPE CM-13" cuts and bevels pipe by oxyacetylene process. Needs only one man to operate it, including setting up of machine, performing cutting operation, and removing machine from pipe. Channel ring fits around pipe, and ring and blowpipe can rotate around entire circumference of pipe in one cut. Additional blowpipe can be mounted on tube-extension arm for double cutting or beveling. Made in one size for cutting 8-, 10- and 12- in. pipe. Designed particularly for this machine is Type C-35 blowpipe, which has combination injector, making it possible to use either low- or medium-pressure source of acetylene.

Linde Air Products Co, 205 East 42nd St, New York, N. Y.



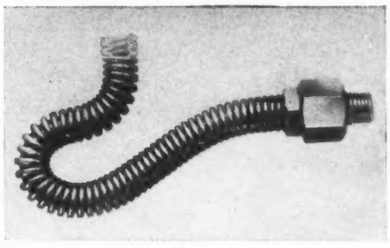
STEAM SEPARATOR

"INTERCEPTOR" is made in sections to allow entrance through boiler manhole. Designed to permit steam flow through interceptor with minimum friction, as all openings are larger than steam-outlet pipe and nozzle is flared at bottom with gradually reduced area down to size of pipe. Annular-shaped trough surrounds bottom of bell-shaped inlet nozzle to intercept any water which would otherwise be carried by friction into steam pipe. Water intercepted by trough is returned through two drain pipes to water space of boiler. Tray below interceptor nozzle prevents water from boiling up and into outlet nozzle, and all water falling into tray is carried below boiler-water level by center drain pipe.

Hoppes Mfg Co, Springfield, Ohio

SEAMLESS TUBING

"T S T TRIPLE Safe Tubing" is a flexible metal hose with its metal braid embedded between two corrugated seamless tubes, forming an all-metal, weldless, jointless, and packless tubing. Can be



cut with hacksaw, and fittings attached. Made of bronze alloy, and to order in aluminum. Standard sizes are $\frac{1}{4}$, $\frac{5}{16}$, $\frac{3}{8}$, and $\frac{1}{2}$ in. in diameter.

Seamlex Co, 5-19 48th Ave, Long Island City, N. Y.

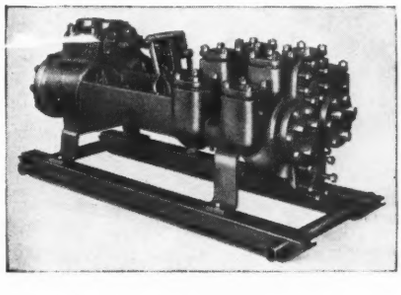
ELECTRICAL-RESISTANT ENAMEL

BLACK ENAMEL dries to a rubber finish, is said to be tough and have high electrical resistance. Applied by spraying for finishing electrical apparatus such as switchboards and instrument boards. Also made in a surfacer with similar properties, for preparing the surface to be finished with this enamel.

Maas & Waldstein Co, 420 Lexington Ave, New York, N. Y.

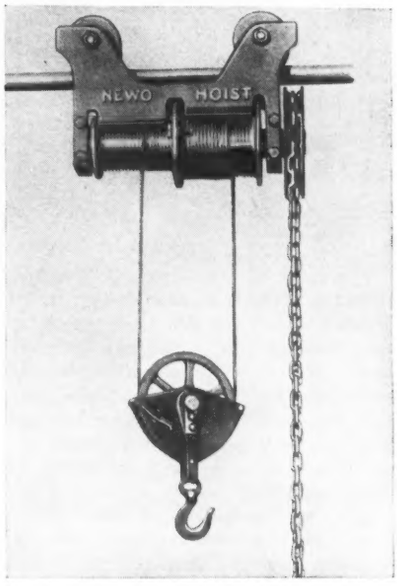
BOILER-FEED AND GATHERING PUMP

LIQUID END on unit, for high-pressure boiler-feed and gathering service in oil fields, is of side-pot type. The machine, a 10x4½x10 Type "PG" duplex steam pump, is rated for working pressure of 1,000 lb per sq in. Individual openings are over each valve, making them easily accessible. Steam valves are designed



for 350-lb steam pressure. All pressure joints have been eliminated by casting steam cylinders and chest integrally.

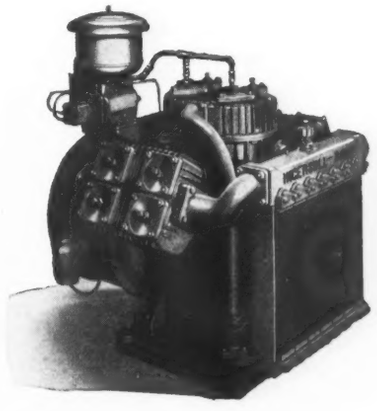
Worthington Pump & Machinery Corp, Harrison, N. J.



SMALL HOIST

WILL HANDLE loads up to 500 lb. Although gearless, has lifting ratio of 15 to 1, obtained by winding cable on large drum as smaller drum unwinds. Motivated bysprocket and endless chain. Latch acts as ratchet while load is raised, and is disengaged in lowering, instantly engaging when released and stopping downward movement. Hoist travels on 1½-in. double-strength pipe or on I-beam.

Newo Hoist Co, 17309 Fernway Rd, Cleveland, Ohio

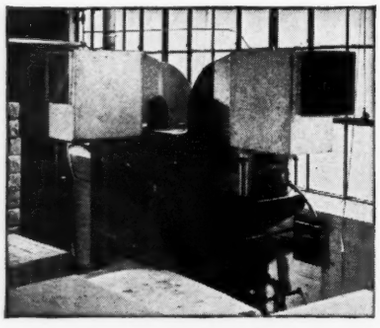


MOTOR-COMPRESSOR UNIT

"MOTORCOMPRESSOR" is a stationary, vertical, single-acting, 2-stage air compressor. Compressor crankshaft carries motor rotor, and compressor frame carries motor stator. Intercooler and radially-placed cylinders are air cooled.

Flexible-coupling and V-belt drives also available. Size range of 15 to 75 hp for discharge pressures from 80 to 125 lb per sq in. Piston displacements range from 79 to 445 cfm. Bulletin 3166.

Ingersoll-Rand, 11 Broadway, New York, N. Y.



HUMIDIFIER

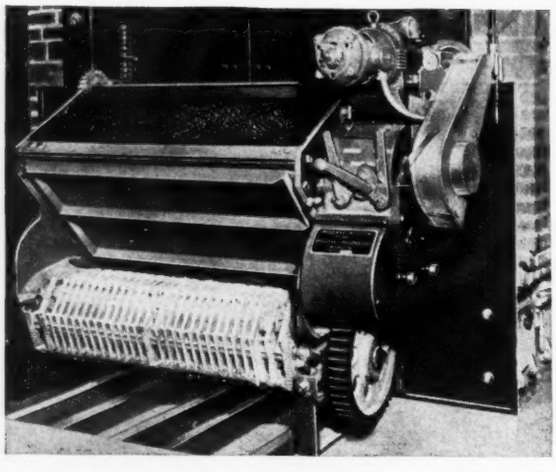
"HUMIDITY BOX" is essentially a spray chamber with water filter and nozzle, air filter-eliminator or baffle, and drain fitting. Where less than 30-lb-per-sq-in. water pressure is available, an electric vaporizer may be used to secure atomization. Although illustration shows two humidifier units on warm-air outlets of blower-type unit heater, humidifier can be used with propeller fan unit heaters, or with any warm-air current, whether in free air or in a duct. Supplied with or without fans or blower units.

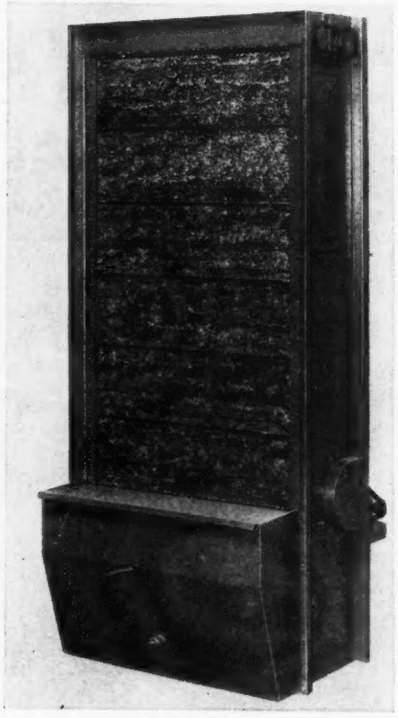
Air Conditioning Supply Co, 1893 E 55th St, Cleveland, Ohio.

CHAIN-GRATE STOKER

SELF-CONTAINED stoker for smaller boiler units has variable-speed drive with constant-speed motor, 3-speed spur-gear driving unit, removable hopper apron, individual damper control for each air compartment, feed-gate indicator, side-wall access door, adjustable front and rear shafts, large hopper capacity. Full automatic control furnished when specified. Will burn smaller sizes of anthracite, coke breeze, mixtures of anthracite and coke breeze, as well as lignite and bituminous fuels.

McClave-Brooks Co, Scranton, Pa.





AIR FILTER

IMPINGEMENT-TYPE filter has four successive stages of filtration, in form of two endless curtains, arranged to rotate so that curtain face, on dirty air side, will be cleaned before returning to clear air side. First stage collects heavier part of dust and breaks up air stream, thus causing it to assume more intimate contact with adhesive surface. First stage then proceeds down to oil bath, and becomes second stage after leaving oil bath and passing compressed-air line from which air is blown to remove oil surplus. Likewise, third stage becomes fourth, and these two operate in comparatively dry state.

Staynew Filter Corp, Rochester, N. Y.

MAGNETIC VALVE

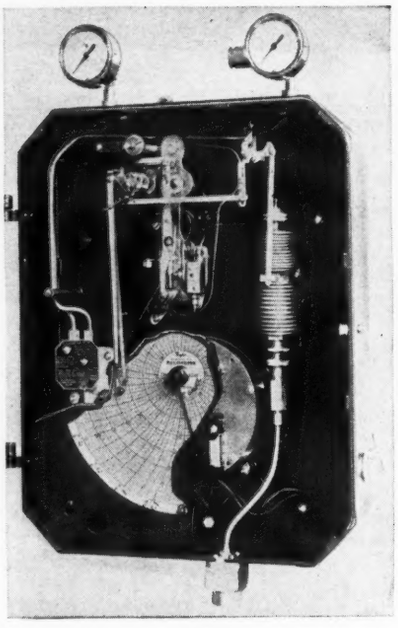
LEVER-ACTION magnetic valve is designed for control of oils as heavy as No. 6 at room temperature, water, air and gas up to 140 lb pressure, and steam up to 125 lb. Valve closes with pressure on top of seat to insure tight closing. Solenoids are removable and coils are water-proof. Terminal connection rotates for ease in wiring.

General Controls Co, 267 5th Ave, New York, N. Y.

ABSOLUTE-PRESSURE INSTRUMENTS

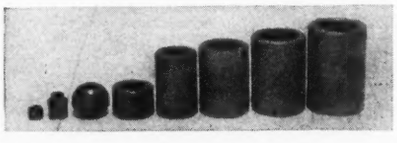
FOR low-pressure measurement, line of instruments for recording, indicating and controlling abs pressure has flexible phosphor-bronze bellows to inside of which pressure medium under measurement is communicated. Connected with this assembly, and opposing its action, is a second identical metal bellows which has been evacuated and sealed, thus comprising an atmospheric-pressure compensator. Applicable to distillation unit, evaporators, condensers, vacuum-return lines, turbine-exhaust pressures.

Taylor Instrument Cos, Rochester, N. Y.



SELF-LUBRICATING BRONZE BEARINGS

MADE OF porous metal impregnated with oil (metal said to have average porosity of 32%, which is fully impregnated with oil). Manufacturer states that bearings

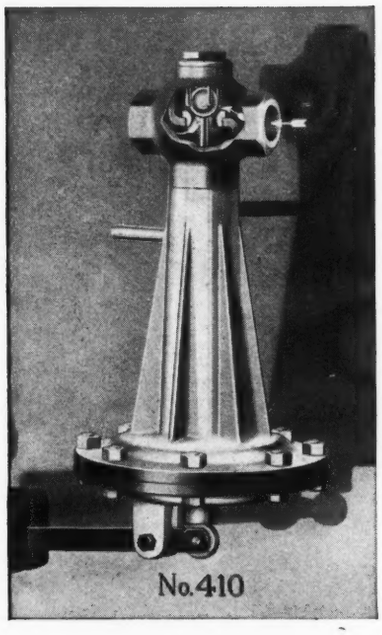


are high in strength and able to stand rough handling without distortion. Can be made in any size straight or flanged, or in any shape which lends itself to molding.

Keystone Carbon Co, St Marys, Pa.

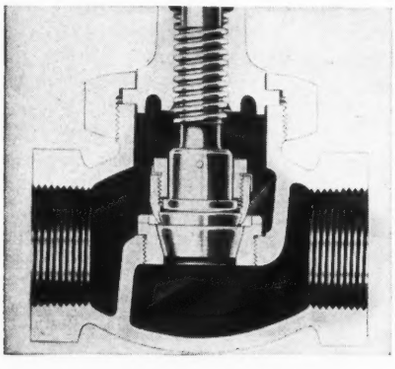
REDUCING VALVES

BALL-TYPE, diaphragm-actuated reducing valves made in three models. No. 400, for pressures of 10 to 50 lb, has interchangeable springs. Springs for larger pressure ranges can be supplied. By taking out four cap screws, spring and diaphragm assembly can be removed while body is under pressure. Valve will operate in any position. No. 410, weight and lever type, for pressure



from vacuum to 50 lb. Pressure is adjusted by changing weight on lever. Roller on end of lever reduces friction and sidethrust. Outlet pressure tends to rise as inlet pressure falls, thus helping maintain full reduced pressure. No. 420, liquid-column type, for any reduced pressure provided sufficient height is available for liquid column. A variation, No. 421, has a small tank of compressed air to load diaphragm in place of static column of liquid. No. 410 illustrated here. Bulletin 361-S.

Klipfel Mfg Co, 2641-59 W Harrison St, Chicago, Ill.



PLUG VALVE

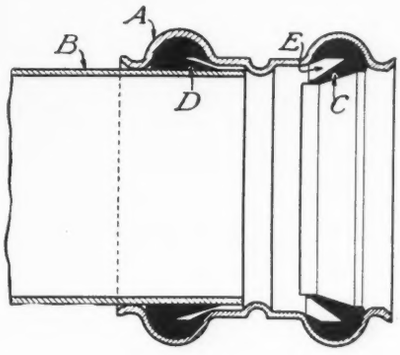
PLUG and seat ring made of "Jenkins JX500", a stainless steel having Brinell hardness over 500. Valve designed for severe service as continuous throttling for pressure reduction or free blow duty as soot blowers, injectors, heating coils, or any steam line where close regulation is required.

Jenkins Bros, 80 White St, New York, N. Y.

FLEXIBLE PIPE COUPLING

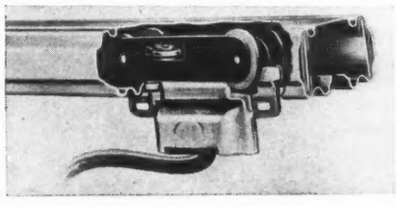
COUPLER, for plain-end pipes, permits substantial changes in alignment, and takes care of all expansion and contraction in pipeline. With couplers, pipeline can be assembled without tools as fast as it can be placed in position. For water lines, gaskets are made of live rubber composition; for oil, gas and certain chemicals, gaskets are made from a duPont "Neoprene" compound which is not affected by exposure to oils, chemicals, heat, sunlight, and aging. *A* is coupler band, B is pipe in place, *C* is self-sealing gasket in place ready for pipe, *D* is gasket with pipe in place, and *D* is cup-shaped groove in gasket.

R H Pierce Mfg Co, 245 Blair St, Eugene, Ore.



MOBILE OUTLET FOR ELECTRIC POWER

"TROL-E-DUCT" consists of section lengths of formed electroplated sheet-steel duct in which are enclosed copper bus bars partially wrapped in insulating material. A narrow slot extending along one side of duct permits insertion of movable current collectors and stationary twistout plugs to which can be



wired tools, lights and appliances. Weight supports inserted in duct can bear weight of heavy lamp fixtures, tools and miscellaneous equipment. With standard couplings, elbows, hangers and other fittings, duct sections can be assembled and installed as compact, continuous flexible distribution system.

BullDog Electric Products Co, 7610 Jos Compau Ave, Detroit, Mich.

UNIT HEATER AND COOLER

DIRECTIONAL rotating louvre can be set at any angle. 2-speed motor gives either high or medium air delivery. All-copper core for heat-transfer surface has heavy seamless copper tubes and copper fins bonded together. Model *A* units has 12-in. fan, maximum air delivery of 334 cfm, heat output 36,600 Btu per hr. For cooling, with ingoing water at 55 F and ingoing air at 95 F, 334 cfm will be lowered to 71 F per min. Model *AA* has

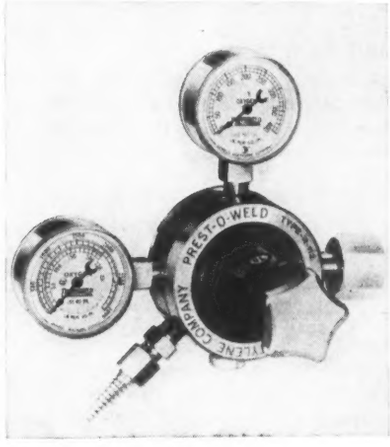
16-in. fan, maximum air delivery of 610 cfm, heat output 54,200 Btu per hr. For cooling, under same conditions, temperature of 610 cfm will be reduced to 71 F per min.

Hexcel Radiator Co, Racine, Wis.

CONVEYOR BELTING

WEFTLESS-CORD construction in which every tension member of belt carcass is surrounded and insulated with rubber, gives long wear and flexibility. Belting is made in all lengths, widths, and number of plies. In installing this belting, manufacturer states that it must be spliced endless on conveyor by portable electric vulcanizing, as to date, no fastener has been devised that will do satisfactory job on this type of belt.

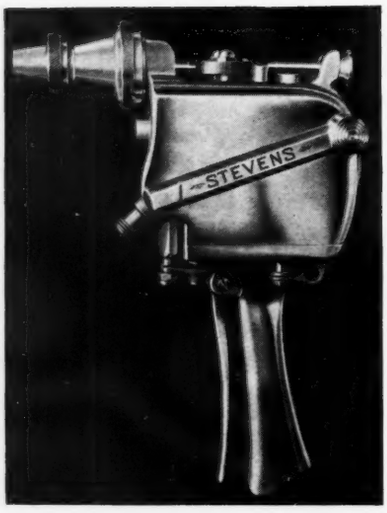
B F Goodrich Co, Akron, Ohio.



OXYGEN REGULATOR

"PREST-O-WELD" Type R 112 oxygen regulator designed for general cutting duty. Operating principles similar to all single-stage regulators. However, certain refinements in designing give greater accuracy and sensitivity in operation. Unit has 400-lb delivery-pressure gage.

Linde Air Products Co, 205 East 42nd St, New York, N. Y.



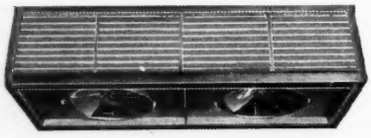
METAL-SPRAY GUN

MODEL OZ-3 has four features. Integral gear shift gives high speeds for low-melting-point metals like tin, lead, zinc; low speeds for spraying aluminum, brass, copper and all steels. High-speed reduction 800-1, low-speed 1600-1, obtained by moving a pin actuating sliding yoke on reduction-gear shaft. Uses ⅛-in. wire throughout. Wire tension automatically controlled by movement of gas-control lever, setting up and releasing tension in synchronism with ignition of combustible gases at nozzle tip. Mechanical assembly removeable from gun body for inspection. 2-piece high-capacity nozzle has positive tapered seats without threads. Tempered tool-steel wire guide section in nozzle for long life. Ten self-lubricated ball bearing on shafts. Construction in general very simple, giving constant feed despite wire kinks, with fine-texture, dense deposit.

Stevens Metal Spraying Inc, San Francisco, Calif.

UNIT HEATER

"MULTIPLE PROJECTION" heater for ceiling mounting has two extended surface coils contained within metal casing. Motors are mounted out of air path;



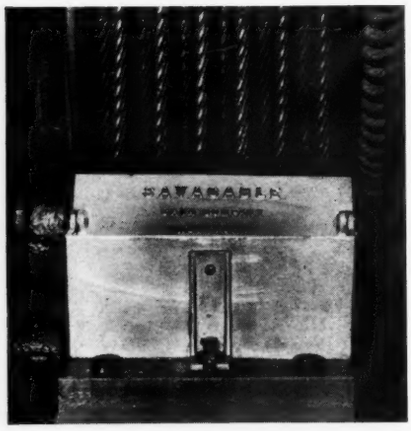
new 4-blade fan is used. Two, three or more fans. This unit is an extension of recently announced single-fan heater.

Trane Co, LaCrosse, Wis.

WIRE-ROPE LUBRICATOR

FOR ELEVATOR ropes, lubricator consists of tank extending across width of rope space, with flat wick extending from tank bottom and pressed tight between tank and ropes. Each rope cuts its own groove half its depth in wick within 1 or 2 hr, then siphon action supplies lubricant. A compression board of special rust- and corrosion-resisting material holds wick in place, and may be tightened down (by adjustment nuts) to retail oil flow. Prevents rope rust, wear between rope and sheave and lengthens rope life.

Sava Co, 205 East 42nd St, New York, N. Y.



CENTRIFUGAL PUMP WITH PRESSED-STEEL FRAME

TYPE CF pumps, for belt or motor drive, are single-stage centrifugal units in capacities of 10 to 300 gpm at heads from 10 to 120 ft. Two grease-lubricated ball-bearings are standard. New YU type pressed-steel frame. Bulletin W-310-B7 on belt-driven, W-310-B8 on motor-driven.

Worthington Pump & Machinery Corp, Harrison, N. J.

RECORDING-CHART INK

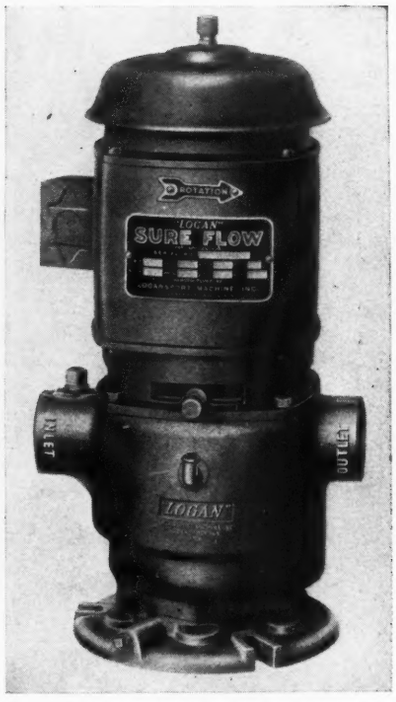
PERMOCHART recording ink, in purple, red or green, especially developed for use on this company's renewable permanent recording charts. Claimed to start flowing instantly and easily without flooding, not to cake on pens even if left run dry for several days, to dry quickly without smudging or spreading.

Permochart Co, Pittsburgh, Pa.

HIGH-PRESSURE BOILER-FEED PUMP

"DOUBLETON" has double suction impellers and double balance of rotating element. Double suction impellers provide axial balance, and positions of successive volute passages surrounding each impeller are designed largely to equalize unbalanced radial forces on impellers. Horizontally split casings (as on steam turbines) for pressures 1500 lb and above, with special high-temperature bolting to maintain tight joint. This new pump can be used for other high-pressure service than boiler feeding; for example, oil pipeline pumps, etc.

Allis-Chalmers Mfg Co, Milwaukee, Wis.



SELF-PRIMING CENTRIFUGAL PUMP

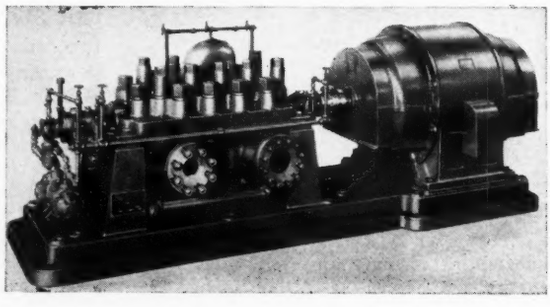
"SURE FLOW" centrifugal pump is self priming and instant flowing. Will handle practically any type of liquid. No metal-to-metal contacts; bearing surfaces protected by rotary seals. Made in nine models, ranging in capacity from 4 to 150 gpm, and with direct motor drive, belt drive, or adapter for direct power takeoff.

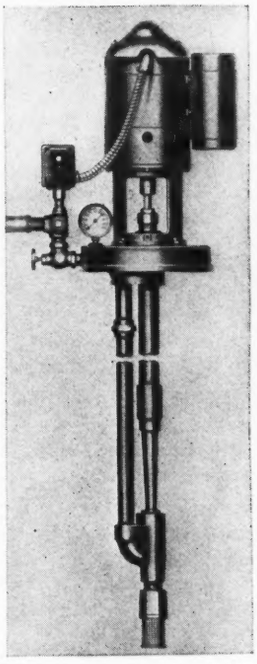
Logansport Machine Co, Inc, Logansport, Ind.

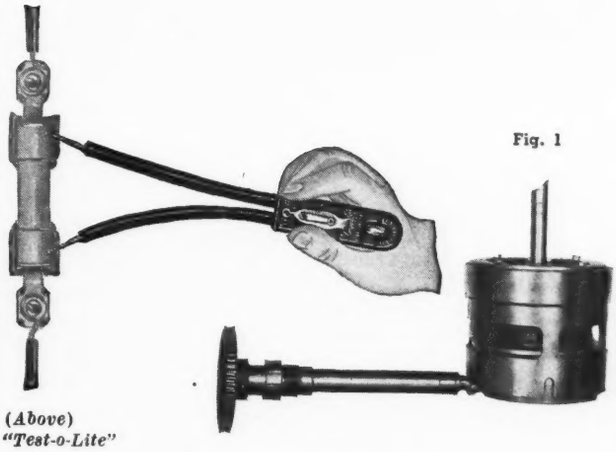
CHAIN-DRIVE BIN-FED STOKER

FOR BOILERS up to 2,500 ft. Designed for use where maximum clearance is needed in front of boiler. Gear case and fan unit mounted next to wall of fuel bin. Power from motor is transmitted by the shaft to back of unit, where chain drive connects shaft and feed worm. Chain drive sealed in grease packing.

Iron Fireman Mfg Co, 3017 W 105th St, Cleveland, Ohio.







(*Above*)
"Test-o-Lite"

Fig. 1

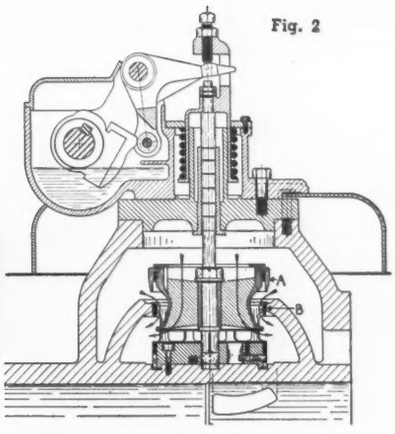


Fig. 2

CENTRIFUGAL WELL PUMP

VERTICAL, close-coupled, motor-driven centrifugal pump for deep or shallow wells has no mechanical moving parts below ground. Units for shallow-well service consist of combined motor, pump and base, into bottom of which is screwed single suction pipe extending below water level. Pumps for deep wells (20 to 200 ft) have ejector and venturi.

Fairbanks, Morse & Co, 900 S Wabash Ave, Chicago, Ill.

ELECTRICAL-CIRCUIT TESTING INSTRUMENT

IMPROVED "Test-O-Lite" has pocket clip for holding instrument in pocket. Also sensitivity has been improved so that instrument detects presence of voltage between 90 and 500 volts ac or dc by small neon lamp in body of tester. For locating burnt-out fuses, leaks, short or open circuits, or wiring defects.

L S Branch Mfg Corp, 55 Dickerson St, Newark, N. J.

CLOSE-COUPLED PUMPS

SPLASHPROOF, direct-mounted pumping units are designed for severe conditions. Self-adjusting rotary seal takes place of usual stuffing box. Wearing rings are renewable for both impeller and casing. Motors are furnished either splashproof or standard construction.

Columbus Steam Pump Works Co, 724 Broderick St, Columbus, Ohio.

LUBRICANT ADDITION

"BALL ROLL" jelly-like lubricating compound is added to oil or grease through normal lubricating devices or points. Claimed to disperse through lubricant in minute particles, forming a semi-fluid oily layer on rotating or sliding parts with three times resistance to compression and nine times film strength of refined petroleum lubricant.

Lubco Corp, Chicago, Ill.

"SLEEVE-POPPET-VALVE" UNIFLOW ENGINE

NEW and simplified poppet-valve gear for variable-speed steam engines adds to regular valve gear a sliding cut-off sleeve with ports in periphery surrounding poppet valve. By simply changing elevation of cut-off sleeve by automatic control, governing rate of flow from a compressor or pump attached to engine, speed can be varied or kept constant. It can also be manually operated with practically no physical effort, essential when cumbersome and heavy gears are employed.

In cross-section, Fig. 2, "A" is upper seat of standard expansion-compensating poppet valve used on all "Universal Uniflow" engines, valve being open. "B" is cut-off sleeve in its lowest position, lower edges of ports in sleeve being on same plane with cylinder seat for valve. The higher sleeve is raised, the shorter the cut-off, as valve lift is constant and cut-off is entirely controlled by sleeve.

Cut-off sleeve has loose sliding fit in valve chest and on valve, no attempt being made to have fit steam-tight. It is raised or lowered by a small double crank engaging grooves in lower end of sleeve, crank being extended through steam chest and connected to a manual or automatic control. Sleeve perfectly balanced against steam pressure.

This valve gear produces sharper cut-off, as action is similar to a sliding valve traveling at full speed and making cut-off while valve is still in rapid motion before it comes to the end of its stroke.

Assembly of valve, cut-off sleeve, and operating shaft with attached gear is shown, in Fig. 1, the sleeve being in a somewhat raised position for an intermediate cut-off.

There will be a slight amount of leakage between period of sleeve cut-off and seating of valve. However, this leakage is claimed to be offset by gain in economy due to elimination of the wire-drawing tendency of any standard cut-off gear during short period immediately preceding instant of seating. Cut-off, therefore, is somewhat sharper and fullness of card greater.

Resultant economy is shown from tests on a 19x20-in. sleeve-poppet-valve engine having full-load rating of 250 hp with an average pressure of 135 lb saturated steam and atmospheric exhaust:

I hp load.....	100	150	200	250
Steam per I hp hr..	18.5	17.7	17.8	18.3

Skinner Engine Co, Erie, Pa.

POWER LINES

$1,200,000 Steam Plant for South Omaha

Nebraska Power Co is constructing a $1,200,000 steam-generating plant at South Omaha which will supply both steam and electric service to Armour and Swift packing companies. The plant, to be completed by June 1, 1938, will include two 175,000-lb boilers and one 5,000-kw back-pressure turbine. The packing companies, which previously have been generating their own steam and purchasing electric service from the utility, will take steam at two pressures, 160 and 20 lb.

This is in addition to a $1,500,000 addition to its steam station in Omaha (see Mid-September *Power*).

Carnegie Tech and Westinghouse to Cooperate

A cooperative educational enterprise which will link Westinghouse Electric and Mfg Co and the Carnegie Institute of Technology in a new program of undergraduate engineering training has been announced by President Robert E Doherty of Carnegie Tech. To make this project possible, and in recognition of other educational services which are being rendered by Carnegie Tech, especially in the Evening School, Westinghouse has appropriated $200,000 to the Carnegie Institute of Technology.

Of the group of students who will be selected to follow the cooperative course, a number, perhaps ten each year, will

receive George Westinghouse Scholarships. A George Westinghouse Professorship of Engineering will also be established, and one of the duties of the holder of this position will be the supervision of the cooperative program.

The Westinghouse appropriation is the largest made thus far to the 1946 endowment fund. In June Carnegie Tech started a drive to raise $4,000,000, one-third of which may be in buildings. If this sum is raised, the Carnegie Corporation of New York will double it, giving $8,000,000 in 1946, thus increasing the endowment of Tech by $12,000,000.

ASME Annual Meeting To Be Held Dec 6-10

Problems of high-presure, high-temperature plants, fuel, and water hammer will be discussed at the 58th Annual Meeting of the American Society of Mechanical Engineers, to be held in New York, Dec 6-10. In a program of wide appeal, there is an unusual number of papers of interest to the power engineer. This is equally true of the inspection trips, which include visits to the engine room of the *Normandie*, Waterside Station of the Consolidated Edison Company, sewage disposal plant at Wards Island and the power plant of R H Macy & Co Inc.

A condensed program, giving events of importance to power engineers, follows:

Tuesday, December 7

Critical Pressure Steam Boilers: 2:00 pm

"Progress Report of an Investigation of the Oxidation of Metals by High-Temperature Steam," by A A Potter, H L Solberg and G A Hawkins

"Protecting Steel from Intercrystalline Cracking in Aqueous Solutions," by W C Schroeder, A A Berk, and R A O'Brien

"Decomposition of Sodium-Sulphite Solutions at Elevated Temperatures," by F G Straub

"Some Results from the Research on Flow Nozzles," by Howard S Bean and Samuel R Beitler (To be read by title)

High-Temperature Joints: 2:00 pm

"Welded Joints," by F L Everett and Arthur McCutchan

"High-Temperature Joints," by Joseph Marin

"Bolted Joints for High-Pressure Vessels," by E O Waters

"Practical Aspects of Turbine Joints," by C B Campbell

"Effect of Temperature Variation on the Creep Strength of Steels," by E L Robinson

Wednesday, December 8

Power: 9:30 am

"Prevention of Slime in Surface Condensers," by R B Martin

"Further Studies of Three-Dimensional Pipe Bends," by William Hovgaard

Heat Transfer: 9:30 am

"Experimental Investigation of the Influence of Tube Arrangement on Convection Heat Transfer and Flow Resistance in Cross Flow of Gases over Tube Banks," by Orville L Pierson

"Experimental Investigation of Effects of Equipment Size on Convection Heat Transfer and Flow Resistance in Cross Flow of Gases over Tube Banks," by E C Huge

"Correlation and Utilization of New Data on Flow Resistance and Heat Transfer for Cross Flow of Gases over Tube Banks," by E D Grimison

"Heat Transfer to Boiling Liquids," by W H McAdams and George A Atkin

Power Panel Discussion: 2:00 pm

"New High-Pressure, High-Temperature Power Stations—The Solution of Unusual Construction Problems; Capacity and Efficiency Performance Data; Troubles with Equipment; Starting-up Procedure." To be discussed by J F Muir, D S Brown, A E Grunert, C H Spiehler, E H Krieg, Louis Elliott, G T Shoemaker, J A Reich, J N Landis, and W E Caldwell

Water Hammer: 2:00 pm

Report of the Committee on Water Hammer, ASME by S Logan Kerr, Chmn

"Air Chambers in Discharge Pipes," by Lorenzo Allievi

"Theory of Resonance in a Pressure Conduit," by Charles Jaeger

"Hydraulic Phenomena in Fuel-Injection Systems for Diesel Engines," by Kalman J DeJuhasz

"Experiments and Calculations on the Resurge Phase of Water Hammer," by J N LeConte

Thursday, December 9

Water Hammer in Hydroelectric Plants: 9:30 am

"Report of Subcommittee on Penstock Failures," by R W Angus, Chmn

"Relation of Relief Valve and Turbine Characteristics in the Determination of Water Hammer," by Earl B Strowger

"Operation of Emergency Shut-Off Valves in Pipe Lines," by F Knapp

"Application of Heaviside's Operational Calculus to the Solution of Problems in Water Hammer," by F M Wood

Fuels 9:30 am

"Water-Cooled Underfeed Stokers," by Joseph S. Bennett

"Industrial Power Plants," by C D Boomhower

Water Hammer in Water-Works Systems: 2:00 pm

"Complete Characteristics of Centrifugal Pumps and Their Use in the Prediction of Transient Behavior," by R T Knapp

"Comparison Between Calculated and Test Results on Water Hammer in Pumping Plants," by O Schnyder

"Graphical Study of Water Hammer in Pump-Discharge Lines," by R W Angus

"Water-Hammer Tests on Transite Pipe," by L H Kessler

"Water-Hammer Problems in Pumping Plants of the Los Angeles Aqueduct," by R M Peabody

"Test on Water Hammer in Pump-Discharge Lines," by E Bruce Ball

Fuels: 2:00 pm

Panel Discussion on Chemically Treated and Dedusted Coal; Deslagging of Boiler Surfaces

20,000-Kw Addition for Baton Rouge, La.

An expansion program involving approximately $2,800,000 will be undertaken in the near future by Louisiana Steam Generating Corp, subsidiary of Engineers Public Service Company, at its Baton Rouge station. The new installation is expected to be completed by December, 1938.

The company plans installation of a 500,000-lb-per-hr boiler to operate at 650 lb pressure, and a 15,000- or 20,000-kw turbine-generator. This will be the first condensing unit in the station. The capacity of the plant now is 45,000 kw, all bleeding units.

While the fundamental fuel is natural gas, boilers are also fired with petroleum waste, soda bottoms, wax tailings, acid sludge and petroleum coke. This type of fuel is obtained from nearby refineries served by Louisiana Steam Generating with both steam and electricity. The plant now has a steam capacity of more than 1,000,000 lb per hr.

John Fritz Medal to Dr Paul Merica

Dr Paul Dyer Merica, director of research of International Nickel Co and vice-president of International Nickel Co of Canada, has been awarded the 1938 John Fritz Gold Medal for important contributions to the development of alloys for industrial uses. The award is made annually for notable scientific or industrial achievement by a board composed of representatives of the four national engineering societies of civil, mining and metallurgical, mechanical, and electrical engineers.

Dr Merica was born in Warsaw, Ind., on March 17, 1889. He studied from 1904 to 1907 at De Pauw University, which in 1934 conferred upon him the degree of doctor of science. In 1909 he received the bachelor of arts degree from the University of Wisconsin, and in 1914 the PhD degree from the University of Berlin. Following five years of work as research physicist in the U S Bureau of Standards, Dr Merica in 1919 became director of research of the International Nickel Company.

Lotz Elected President of Stone & Webster

JOHN R LOTZ has been elected president of Stone & Webster Engineering Corp, New York, N. Y., succeeding James H Manning. Mr Lotz, who has been associated with Stone & Webster for 30 years, has been executive vice-president of the corporation for the past

seven years, and before that was construction manager. Mr Manning, who resigns as president and chairman of the board in order to devote more time to personal affairs, will continue his association with Stone & Webster in a consulting capacity.

Engineering Schools Accredited by ECPD

For the first time in the history of engineering education in the United States, engineering curricula throughout the country have been appraised by a representative body of engineers, and a single accredited list has been published of courses of study deemed worthy of approval. The accrediting process has been carried out during the past two years by the Engineers' Council for Professional Development, a joint organization created by seven national engineering societies for the purpose of enhancing the status of the engineering profession. The participating groups are: American Society of Civil Engineers, The American Society of Mechanical Engineers, American Institute of Electrical Engineers, American Institute of Mining and Metallurgical Engineers, American Institute of Chemical Engineers, The Society for the Promotion of Engineering Education, and National Council of State Boards of Engineering Examiners.

Announcement of the accredited list, including those curricula examined last year in the New England and Middle-Atlantic States, was made at the fifth annual meeting of ECPD on October 1, 1937. On that date, 107 engineering schools had been visited and 445 curricula accredited in 16 branches of engineering. Committees of inspection throughout the country numbered 102 engineers.

Requests for further information regarding ECPD and the accrediting program may be addressed to A B Parsons, Secretary, Engineers' Council for Professional Development, 29 West 39th Street, New York, N. Y.

Advisory Counsel for Coal Users

Consumers' Counsel of the National Bituminous Coal Commission, Washington, D. C., recently published a booklet "How Much Heat," which outlines a consumer plan for determining the relative values of bituminous coals, and tells how the plan would benefit consumers if adopted. Single copies of the booklet may be obtained gratis by writing to the Counsel, Box 483, Washington, D. C. Quantity orders must be sent to Supt of Documents, Washington, D. C.; price 10 cents per copy.

The Counsel is independent of the Bituminous Coal Commission, and is intended to represent interests of the consumer public. He is appointed by the President of the U S with the advice of the Senate. Under laws passed by Congress, it is the duty of the Consumers' Counsel to appear in the interest of the consumer before the National Bituminous Coal Commission, and to conduct any independent investigation relative to the coal industry deemed necessary.

This means that any consumer who wishes to present pertinent data to the NBCC in any of its hearings may notify the Consumers' Counsel in advance, and learn of any proceedings. The Counsel also stands ready to advise inquirers by mail (or by telegram in urgent cases) on the status of the hearings which are being held almost continuously by the Coal Commission, or in regard to any closely related matters.

OBITUARIES

DR BAILEY TOWNSHEND, 42, for the past seven years director of the research laboratories at the Manville, N. J., plant of Johns-Manville corporation, was found dead of poisoning by illuminating gas at his home in Plainfield, N. J., Oct. 18. Dr Townshend was graduated from Massachusetts Institute of Technology in 1916, and later served on the teaching staffs of M I T and Yale.

COL STEPHEN A DOUGLASS, 58, consulting engineer of 660 Fort Washington Ave., New York, N. Y., died recently of heart collapse. Col Douglass, who served as a military observer in France with the Canadian and Australian combat forces, and later with the Chemical Warfare Service of the U S Army, was graduated from M I T, and served with General Electric Co. He later became a partner in the former firm of McGovern Co (later McGovern-Douglass Co), and in 1924 formed his own consulting organization in the power generation and transmission field.

Lately Col Douglass has been working with Dr Alvin Barach of the Columbia University Medical Center in the development of a mechanical lung, which is now being tested. The firm, which also handles liquidation of complete power plants, will continue under the direction of his widow, Mrs Zoha Douglass, in association with F William Stocker.

ARTHUR KRUMPF, 56, operating engineer at the plant of Ward Baking Co, Providence R. I., died suddenly in that city on Oct. 19.

PERCY C. BROOKS, 65, former executive vice-president of Fairbanks, Morse & Co, Chicago, Ill, died at his home in Chicago Oct 15 after a lingering illness of about a year.

GEORGE R MCLEAN, 58, since 1930 superintendent of the British Columbia Railway Co's power plant at Ruskin, B. C., died recently after a brief illness.

WILLIAM R DEWEY, 74, president and treasurer of Waters Governor Co, Everett, Mass., died at his home in Newton, Nov. 1.

WILLIAM C BUELL, 81, assistant treasurer of Builders Iron Foundry, Providence, R. I., and vice-president of the affiliated Diamond Machine Co, died Oct 21 while en route to California on the steamship "President Taft." For many years he headed the sales departments of both companies.

ALEX T SJOBLOM, 55, electrical distribution engineer, Public Utility Engineering and Service Corp, died Oct 22 at Tucson, Ariz, while en route to Mexico on a business trip. Mr. Sjoblom served with Commonwealth Edison, Isthmian Canal Commission in the electrical and mechanical depts, as a consulting engineer, and as sales engineer for Fairbanks Morse & Co before joining the public utility.

MEETINGS

American Institute of Electrical Engineers—*Winter convention, New York, N. Y., January 24–28. H H Henline, national secretary, 33 W 39th St, New York, N. Y.*

American Society of Heating & Ventilating Engineers—*Annual Meeting, Jan 24–28, Biltmore Hotel, New York, N. Y. A V Hutchinson, secretary, 51 Madison Ave., New York, N. Y. Concurrently with the meeting will be held the 5th International Exposition of Heating, Ventilating and Air Conditioning at the Grand Central Palace, New York, N. Y., Charles F Roth, manager.*

American Society of Mechanical Engineers—*Annual Meeting, Dec 6–10, Engineering Societies Bldg, New York, N. Y. C E Davies, secretary, 29 W 39th St, New York, N. Y.*

American Society of Refrigerating Engineers—*Annual meeting, Jan 26–28, Roosevelt Hotel, New York, N. Y. David L Fiske, secretary, 37 West 39th St, New York, N. Y.*

Chemical Industries—*Sixteenth Exposition, Dec 6–11, New York, N. Y. Charles F Roth, International Exposition Co, Grand Central Palace, New York, N. Y.*

Drying and Air-Conditioning Symposium—*Dec 27–28, University of Pennsylvania, Philadelphia, Pa. Under auspices of Div of Industrial and Engineering Chemistry, American Chemical Society. Symposium chairman, D B Keyes, Dept of Chemistry, University of Illinois, Urbana, Ill.*

National Warm Air Heating and Air-Conditioning Association—*Winter convention, Jan 24–26, Roosevelt Hotel, New York, N. Y. Allen A Williams, managing director, 50 W Broad St, Columbus, Ohio.*

STRAWS

Pointing the way business winds blow

ALABAMA —— Mohawk Silica Corp, Birmingham, plans boiler house at new silica processing in Calhoun County, near Ohatchee. Cost close to $70,000.

ARIZONA —— Tombstone plans pipelines for municipal gas-distributing system. Cost about $26,000. Headman & Ferguson, Phoenix, consulting engineers.

Arizona Electric Power Co, Winslow, has authorized installation of 1050-hp diesel-generator unit and auxiliary equipment in local power plant. Cost about $100,000.

ARKANSAS —— Board of Trustees, State School for Blind, Little Rock, plans central-heating plant in 2-story institutional building in vicinity of State School for Deaf. Cost about $300,000.

CALIFORNIA —— Palomar Refining Co, Bakersfield, plans boiler house, pumping station, steel-tank storage and other equipment at new gasoline-topping plant in Fruitvale oil field area, about two miles from Bakersfield. Cost over $80,000.

Board of Education, Bakersfield, plans central-heating plant in 2-story junior high school at East Bakersfield. Cost $420,000.

Johnston Fruit Co, Santa Barbara, plans boiler house at new fruit packing plant at Quinientos and Salsipuedes Sts, to cost close to $100,000. W W Ache, 301 North Citrus Ave, Los Angeles, architect.

Inglewood Gasoline Co, 607 Aerick St, Inglewood, contracted Rapid Construction Co, 4090 East Washington Blvd, Los Angeles, for 1-story engine house, pumping station and cooling towers at local plant. Cost over $50,000, Aaron J Smith, Long Beach, engineer.

H A Murray, Times Bldg, Long Beach, plans power plant for central-heating service and electric substation for light and power in new 13-story hotel building. Cost about $1,500,000.

CONNECTICUT —— State Dept of Public Works, State Office Bldg, Hartford, plans steam-distribution system in buildings at Connecticut State College, Storrs, including improvements in power house. Cost close to $180,000.

DELAWARE——Delaware Hospital, Wilmington, Frank V duPont, chairman of building committee, plans central-heating plant in multi-story hospital building. Cost close to $1,000,000.

FLORIDA —— City Commission, Jacksonville, contracted Babcock & Wilcox Co, New York, N.Y., for watertube boiler, superheater and accessories for municipal electric power station on Talleyrand Ave., at $108,381. Also, contracted Combustion Engrg Co, New York, N.Y., for furnace unit and auxiliary equipment, at $123,755; Westinghouse Electric & Mfg Co, East Pittsburgh, Pa., for motors, controls and accessory apparatus, at $26,362; Alco Products, Inc, New York, for closed heaters, dome coolers and auxiliaries, at $24,144; Green Fuel Economizer Co, New York, for fuel economizer apparatus, including fans, dampers, etc, at $16,739; and R D Cole Mfg Co, Newnan, Ga., for ducts, flues, etc, at $17,890.

Apte Canning Co, Miami, plans steam power house at new branch food-canning plant at Edinburg, Tex.. where large tract of land has been secured. Cost close to $50,000.

GEORGIA —— T G Strange, Rome, plans modernization of boiler house at former plant of Orangeburg Packing Co, Orangeburg, S. C. Work will be carried out in connection with remodeling and equipping entire fruit packing plant, estimated to cost over $100,000.

ILLINOIS —— State Division of Architecture and Engrg, Capitol Bldg, Springfield, plans modernization in power house at institution at Stateville.

Greater Peoria Sanitary and Sewage District, Peoria, plans remodeling of engine-generator station, with installation of new

(*Continued on page* 128)

NEW PLANT CONSTRUCTION

McGraw-Hill Business News Department Is Prepared to Furnish a More Complete Daily Service

Arizona and New Mexico—San Simon Rural Electrification Administration Cooperative Assn., San Simon, Ariz., applied for $200,000 loan from REA to be used in construction of power plant, 780 kilovolt-ampere capacity at Rodeo, N. M., and approximately 77 mi. transmission lines most of which will be in Arizona. The main purpose of project is to obtain inexpensive power from pumping water used in irrigation 70,000 acres undeveloped land.

Ariz., Winslow—Arizona Electric Power Co., c/o J. Baird, mgr., furnishing, installing 1,050 hp. diesel plant, extending present power house building and raising cooling tower, day labor, $100,000.

Ark., Anadarko — City made preliminary plans installing 5,000 hp. diesel engine and generator for light plant. $75,000. N. Kinkel, Anadarko, engr.

Calif., Avon—Pacific Gas & Electric Co., 245 Market St., San Francisco, and Tidewater-Associated Oil Co., have entered into a co-operative agreement by which the former will supply the latter with electric power and steam needed in refining processes and purchase from the Tidewater-Associated, fuel oil and waste fuel for operating the electric generating plant. Similar negotiations are under way for plants at "Union" and "Shell" refineries in Contra Costa County. Plant will consist of single 35,000 k.w. turbo-generator. $5,000,000. Engineering Dpt. of owners, engrs.

Calif., Fresno—San Joaquin Light & Power Co., Power Bldg., Fresno, completing plans rein.-con. sub-station, G St. between Mariposa and Fresno Sts. $75,000. Engineering Dpt., c/o owner, engr.

Calif., Sacramento — Sacramento Municipal Utility Dist., A. Givan, ch. engr. and genl. mgr., plans constructing 201,000 h.p. hydro-electric project in El Dorado County on Silver Creek and the South Fork of the American River, in 2 stages, the first to consist of two storage reservoirs, connected by a tunnel, diversion dam, conduit and a power house, to be known as the Brush Creek Development, which will have an installed capacity of approximately 50,000 h.p. Ultimate development of the project will consist of the enlargement of the 2 storage reservoirs and the construction of 2 additional diversion conduits and 2 additional power plants, to be known respectively as the Big Bend and Chili Bar plants, which will raise the total installed capacity to an aggregate of 201,000 h.p. Est. $12,000,000.

Conn., Essex — Connecticut Light & Power Co., 36 Pearl St., Hartford, plans being completed by L. Hamilton, 22 Church St., Meriden, brick, steel power sub-station. $40,000.

Del., Wilmington—Delaware Power & Light Co., 6th and Market Sts., plans enlarging Christiana Sub-station by 25,000 kva., incl. installing 3 large transformers, together with necessary oil circuit breakers, disconnecting switches, control and equipment, auxiliary apparatus and improvements and additions to existing steel structure. $300,000.

Ia., Morning Sun—Bids Nov. 29, by Town Council, installing diesel plant and electrical distribution system, incl. 2 or 3 diesel engines, generators, exciters, compressed air starting devices, forced feed lubrication system, storage tanks, fuel meter lubricating oil coolers, air filters, exhaust silencers, intake silencers, air compressor, air tank, hoist and trolley, piping, cooling tower, panel switchboard, distribution system, poles, street lamps, transformers, ornamental standards for street lighting. $65,200. R. W. Gearhart, Cedar Rapids, engr.

Ind., Washington—Bd. P. Wks., City Hall, soon takes bids constructing 3,000 kw. turbo-generator set for municipal light plant. Bevington-Williams, Inc., 1139 Indiana Pythian Bldg., Indianapolis, consult. engrs.

Kan., Peabody—City c/o Mayor A. Gilliilan, plans new light and power plant. **$85,000. Maturity soon.** E. T. Archer & Co., New England Bldg., Kansas City, Mo., engrs.

Ky., Henderson — Bd. City Comrs. soon takes bids municipal light plant improvements, incl. new boiler, feed water pumps, circulating pumps. $33,000.

Mich., Dearborn—Ford Motor Co., Schaefer Rd., plans addition to hot steel mill building, incl. strip mill for 60 in. sheets, 2 slab reheating furnaces, finishing stand, concrete pile and caisson founds., River Rouge site; furnishing one 110,000 kw. turbo-generator unit for expansion of power plant at River Rouge plant. Giffels & Vallet, 1000 Marquette Bldg., Detroit, engr.

Mich., Traverse City—Municipality plans electric light and power plant. $125,000.

Minn., New Ulm—City, A. C. Sannwald, clk., plans furnishing, installing equipment at municipal power plant, incl. turbine generator. $40,000 (not official). C. W. Frank, city engr. R. D. Thomas & Associates, 1200 2nd Ave. S., Minneapolis, consult. engrs.

Minn., Westbrook—Village, c/o T. V. Peterson, clk., plans electric light and power plant. $70,000 bonds voted.

Miss., Morton—Adams-Edgar Lumber Co. plans rebuilding portion of mill recently destroyed by fire, incl. saw mill, machine shop and power station. $100,000. Plans installation power equipment.

Mo., Jefferson City—Missouri State Penitentiary and Bi-Partisan Advisory Bd. of State Building Comn., E. M. Eagan, executive secy., soon takes bids altering power plant building, stokers, boilers, generating equipment, electrical distribution lines at Missouri State Penitentiary. $450,000. P.W.A. project. C. A. Haskins, c/o owner, engr.

Neb., Battle Creek—City voted $68,000 bonds for constructing building, generating plant and distribution system.

Neb., O'Neill—Interstate Power Co., Dubuque, Ia., plans construction brick building for plant and installation 1,500 h.p. generating unit for emergency use. $75,000 and up.

N. J., Burlington—Public Service Electric & Gas Co., 80 Park Pl., Newark, constructing addition to steam electric power plant to house a 100,000 kw. turbine and 2 boilers, to United Engineers & Constructors, 1401 Arch St., Phila., Pa., without competition. Equipment will be purchased by contractors. Total $10,000,000, incl. equipment. **Maturity 1938.**

New York—New York State Electric & Gas Corp., Watkins Glen, have filed petition with Public Service Comn. of New York, Albany, for permission to construct electric plants in towns of Veterans, Horseheads, Baldwin and Chemung and in villages of Odessa, Burdett and Lodi. To exceed $100,000. **Maturity 1938.**

N. Y., Baldwinsville—Village plans construction of municipal power plant.

N. Y., Endicott—Bd. Village Trustees plan constructing municipal power plant addition and extension of facilities. Maturity pending legal decisions. L. L. Mathews & Associates, 170 Bway., New York, engrs.

N. Y., Oneida—Oneida Community Ltd., Kenwood, constructing power house, own forces. Owner will purchase materials. E. D. Pitt, c/o owner, engr.

O., Wooster—Wooster College plans power house on campus to furnish heat and electricity to 18 buildings. $200,000.

Okla., Hollis—City plans municipal electric light plant and distribution system. $135,000. Bonds voted. I. Jones, Fidelity Bldg., Oklahoma City, engr.

Okla., Vinita—Grand River Dam Authority, Vinita, appointed W. R. Holway, Tulsa, consult. engr. constructing dam for Grand River Power Project. $20,000,000.

Pa., California—Commonwealth of Pennsylvania, 600 North 2nd St., Harrisburg, completed plans heating and power plant, incl. water and steam lines, emergency lighting equipment. $175,000. S. Lloyd Beal, Washington Trust Bldg., Wash., Pa., archt.

Pa., Perkasie—Boro Council, Phares Bader, secy., plans electric plant, may erect addition to present building or new plant in different location.

Pa., Reading—City defeated bonds, constructing municipal light and power plant. $4,750,000. Burns & McDonnell Eng. Co., 107 West Linwood Blvd., Kansas City., Mo., engrs.

S. D., Freeman—Bids Dec. 8, by City, constructing electric light and power plant and distribution system. $98,000. Buell & Winter, 508 Insurance Bldg., Sioux City, Ia., engrs.

Tex., Grand Falls—Bids Nov. 30 by Red Bluff Water Power Control Dist., c/o C. E. Barron, pres., Pecos, power plant improvements, incl. constructing 56 mi. 33 k.v. transmission line extension, one 1,000 kw. 33 kv. sub-station, 4 small 33 k.v. sub-stations, one 1,000 kw. diesel generating plant, extensions of 11 k.v. lines, 44 k.v. distributor systems and purchase of store room supplies for Red Bluff Water Power Control Dist. $213,000. P.W.A. project. J. D. Shaw, Pecos, engr.

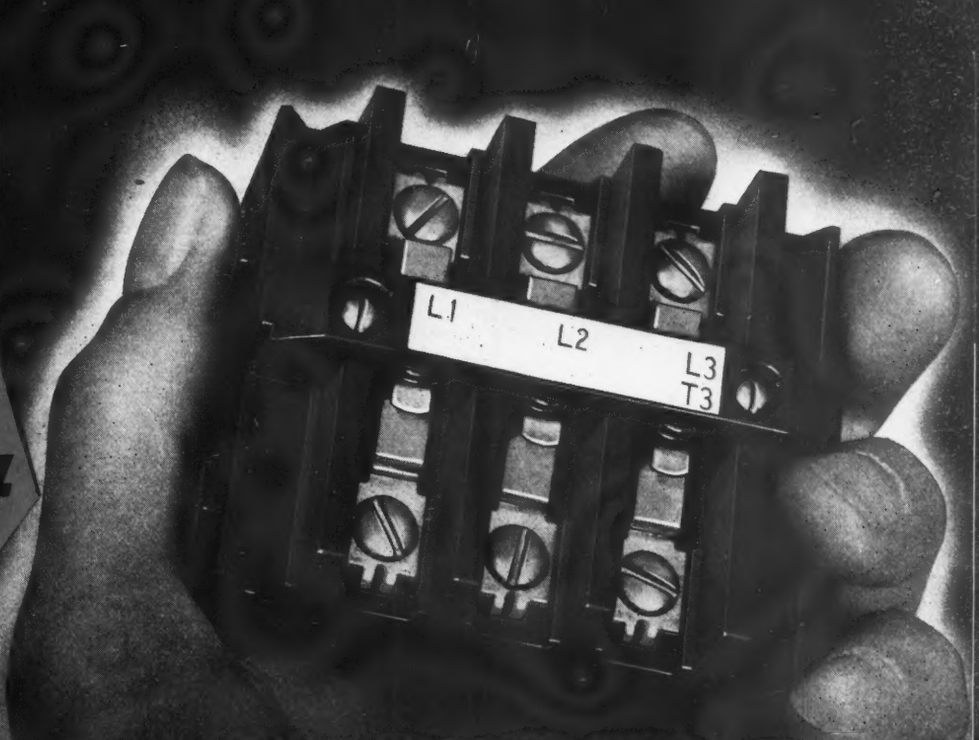
Washington — Bids Dec. 10, by Bureau Reclamation, Dpt. Interior, Civic Bldg., Spokane, completion of Grand Coulee Dam, left powerhouse, and foundation for pumping plant, Columbia Basin Project, about 100 mi. west of Spokane. Spec. 757.

Wis., LaCrosse—Wisconsin State Teachers College plans steam electric power plant. $100,000.

Alta., Lake Athabaska—Consolidated Mining & Smelting Co. Ltd., Trail, B. C., soon takes bids constructing 1,000 ton mill and 3,000 h.p. power plant to serve same, power plant will be built 23 mi. away from mill and necessary transmission lines strung on 60 ft. towers. $2,500,000.

Ont., Arnprior — Ontario Hydro Electric Power Comn., 130 University Ave., Toronto, constructing dam and powerhouse at High Falls on Madawaska River, 20 mi. upstream from here, own forces. $3,600,000. Bids early in 1938, general equipment, generator will consist of 2 units total 36,000 hp.

This is the heart - of a new high in starter design



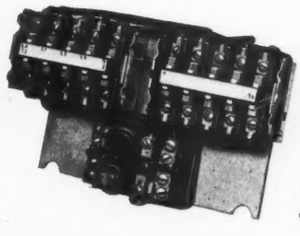
. . . This "heart" of the new Cutler-Hammer line . . . a remarkable new small-size structure permits advantages never available before

BULLETIN 9115 MANUAL
(NEMA Size 0 Non-reversing)

Modern styling. Japanned steel case. Also skeleton mounting for built-in use. Push-button start, stop, overload reset. Start button and case can be locked against tampering. Improved C-H Eutectic Alloy, free-tripping thermal overload relay of new unit construction. Starter rating changed by changing heater coils.

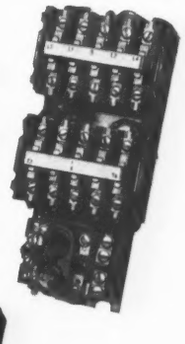
BULLETIN 9592 AUTOMATIC
(NEMA Size 0 Non-reversing)

All moving parts pivoted for correct alignment, quiet operation, absence of friction. Magnet coil vacuum-impregnated, long-lived, moisture-proof, heat-conducting. Safe pick-up and drop-out voltage assured. Also skeleton mounting for built-in use.



BULLETIN 9595
AUTOMATIC REVERSING
(NEMA Size 0)

Offers all features of this new C-H design including improved thermal overload protection with overload indication. Horizontal or vertical arrangement as desired in either skeleton or standard enclosures.

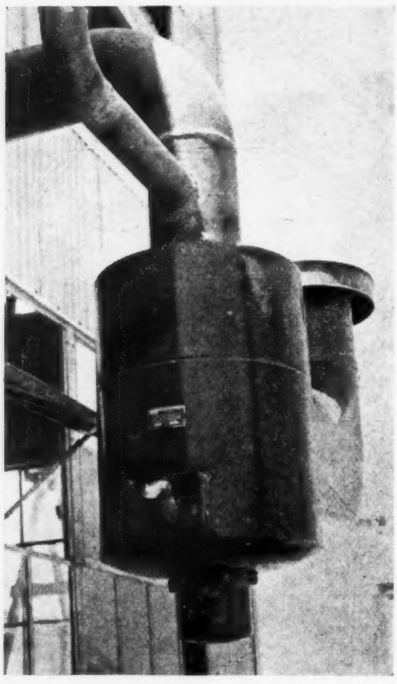


CUTLER-HAMMER
MOTOR CONTROL
C-H

FOR a.c. motors 2 h.p. and below . . . in a small size never before achieved. They possess a ruggedness and dependability never before available in this size, and an ease of accessibility which traditionally belongs to much larger units. From such minor details as self-centering terminal screws to such major features as the new improved C-H Thermal overload, this Motor Control is packed with advanced engineering features. For the first time this new C-H line offers interchangeability of parts between manual and automatic Motor Control. New simplicity is achieved. For example, loosen one screw to remove the entire operating mechanism. The operating mechanism is mounted on rubber to lessen vibration. Lightning fast twin-break, silver-to-silver contacts; unit base construction; better-vision interiors . . . these are but part of the amazing list of features. And in a size never before achieved.

AND AT A PRICE! You will want to know this line, the best news of the day for machine designers and machine buyers alike. Write or wire for complete details. CUTLER-HAMMER, Inc., *Pioneer Manufacturers of Electric Control Apparatus*, 1358 St. Paul Ave., Milwaukee, Wis.

PRACTICAL AIDS TO OPERATION



Improving Performance of Diesel Compressors

FOR THREE 600-hp, air-injection diesels driving a main line pump station, intake air was brought into the station through a 10-in. line terminating in an air cleaner outside the plant. Suction to the compressor on each unit was originally equipped with an individual air cleaner on a short stub mounted on the engine. This arrangement was discarded because of danger of oil vapors being released in the station and drawn into the compressor, where diesel-ignition temperatures might cause a serious explosion. Air intakes were then tied into the nearest point on the 10-in. main air inlet, a 4-in. inlet being welded into the 10-in. line with a short run of less than 3 ft to the ell entering the compressor intake.

Almost immediately compressor troubles developed. Bearings would pound, the compressor cylinder would sometimes fail to fill, and on the next stroke would exceed normal pressure, causing violent fluctuations in the pressure gauge and connections; and the compressor would vibrate and tend to run hot.

Trouble was traced to the main volume of air travelling through the 10-in. main. This air had a pulsating motion corresponding to intake demands of main-engine cylinders. When compressor suction coincided with a comparatively rarefied spot in the moving air column, the cylinder would fail to fill completely. If the opposite occurred and the compressor began suction when air in the 10-in. line was slightly compressed, the volume of air taken in would exceed normal.

This was corrected by changing the compressor intake from within the building to a point outside the wall, just above the main air cleaner, as in the figure. This change required a 40-ft connection to the compressor, but, as the air was taken from the main where the engine suction did not cause serious pulsations, and the long intake connection acted as a dampener, the compressor ran smoothly.

Longview, Texas ELTON STERRETT

Unburned Combustible Reclaimed from Breeching

MANY pulverized-coal boiler plants operate at a considerable loss due to unburned combustible, usually in the form of carbon particles in flyash. One plant recently investigated poor draft, and found several tons of unburned combustible in the breeching and economizer casing.

Much can be said about reducing amount of unburned combustile by control of pulverization fineness, fuel-air ratio, and furnace turbulence. But, the fact remains that there is always a certain amount of this carbon-bearing ash in flue gas. It is heavier than flyash and usually passes in the bottom strata of the breeching.

A rather ingenious method of reclaiming this soot is installed in a large paper-mill boiler plant. Fig. 1 shows the general set-up of the apparatus and Fig. 2 gives the details of the fittings used. A standard soot hopper in the breeching has a baffle plate extending about 4 in. above the bottom of the breeching to intercept the lower strata of soot-bearing gas. A sliding gate is in the bottom of the hopper and a 7-in. pipe leads directly into the side outlet of a 7-in. lateral. The outlet of this lateral is connected

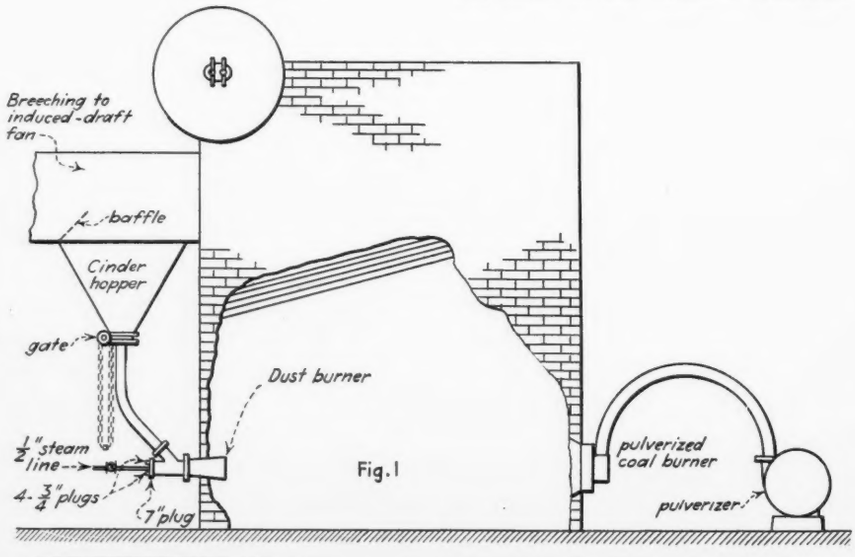


Fig. 1

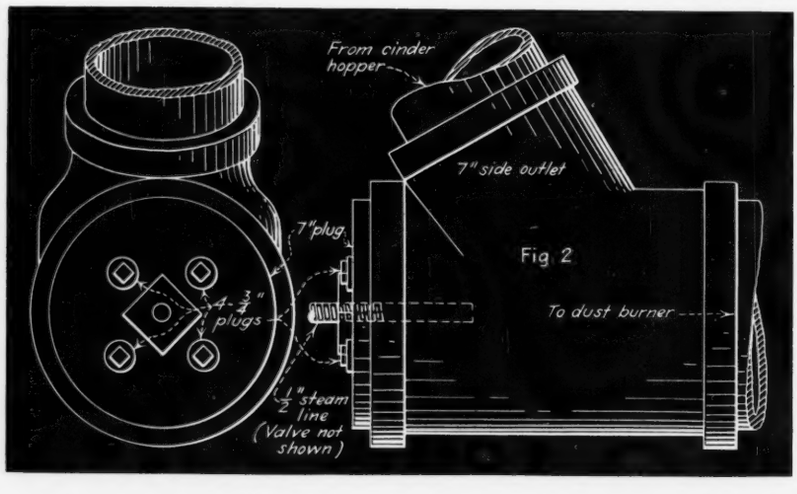


Fig. 2

"We Have Replaced $2000.00 Worth of Old Type Traps with YARWAYS"

"We Found It Cheaper Than Making Repairs"

(Reports Refrigerator Mfr.)

How to end Steam Trap troubles? Ask Yarway Trap users. They will tell you about their:

QUICKER HEATING . . . hours saved in starting up.

GREATER SUSTAINED HEATING EFFICIENCY . . . keeping machines, equipment and heating systems hotter, all the time.

LOW MAINTENANCE . . . where other type traps have required frequent renewal of parts, Yarways stand up.

FUEL SAVINGS . . . through proper draining and elimination of air-binding and through less radiation loss due to the small size of Yarway Traps.

EASE OF INSTALLATION . . . requiring no supports, less space. Same trap without change is applicable to almost all requirements, up to 400 lbs. pressure. (All-steel, stainless-steel-trimmed traps for pressures up to 600 lbs.)

LOW PRICE . . . often, as the user above testifies, it costs less to install new Yarways than to bother with repairing other type traps.

Ask Yarway Trap users, or better yet—get some Yarway Traps, try them out in your own plant, write your own testimonial. Thousands of Yarway Impulse Traps have been bought in this way. It's the way we would rather win many more thousands of satisfied users.

A nearby mill supply house handles them (more than 100 leading distributors in principal cities). Catalog T-1722 sent on request.

YARNALL-WARING COMPANY, 100 Mermaid Ave., Phila.

YARWAY IMPULSE STEAM TRAP

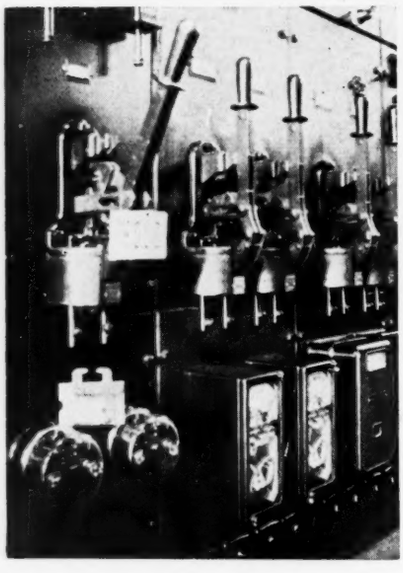
The Trap Everyone is Talking About

with a Venturi-type burner in the rear of the furnace wall. One burner is shown, but in one such installation, three burners are installed in each boiler. The 7-in. plug in the opposite end of the lateral is drilled and tapped in the center for ½-in. pipe. Each quarter of the flat portion of the plug is drilled and tapped for a ¾-in. pipe plug. A ½-in. pipe, threaded for about 1 ft, is screwed through the center tapping, and connected through a union, globe valve, and flexible connection to the superheated-steam header at boiler pressure. The four ¾-in. openings are fitter with plugs put in finger tight.

In operation, the ½-in. union is loosened slightly, and the ½-in. pipe adjusted in position so its end comes about under the lateral's side outlet. Two or more of the ¾-in. plugs are removed and the hopper gate opened so that a steady stream of soot flows to the lateral. The ½-in. steam valve is opened just enough to blow the soot through the burner and form a good flame.

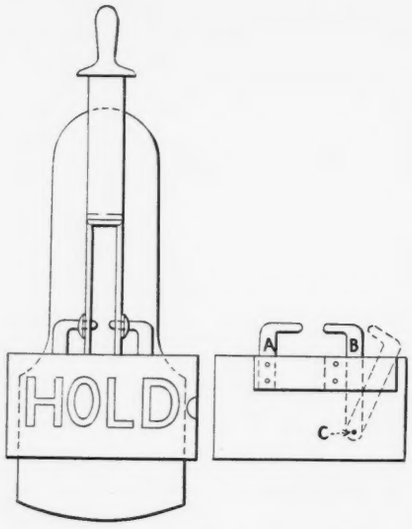
A little experience in making the adjustments will show a noticeable saving in fuel consumption. An added advantage of this system is that it gives increased furnace turbulence and secondary air at an advantageous location. When operating the boiler with a soot burner out of service, all four ¾-in. plugs are left out to prevent overheating of the burner.

Boston, Mass. C O DIBBLE



Warning Holder Blocks Oil Circuit Breaker

AS A SAFETY device, I have developed a holder for attaching warning cards and for blocking open manually-operated oil switches. The holder is made of ⅛-in. white fiberboard as indicated in the drawings. Attachment *A* is riveted rigidly to main part of the holder and *B* pivots on a rivet at *C*. *B* swings out until the holder is in place, then it is moved in to complete the connection.



Connection ends are placed in the trip-free slots in the operating bars behind the bolts, so that the switch handle cannot be pulled out far enough for the closing toggle to drop into place, thus preventing anyone from closing the switch. The face of the holder is covered with thin transparent celluloid to form a receptacle into which different types of warning cards may be slipped.

Kearney, Neb. HAROLD MOHLER

Through Stays on Boiler Straightened

RECENTLY, a boiler inspector requested that the through stays on a 22-year old hrt boilers be straightened, as they had become bowed about 1.5 in. Two boilermakers called in to look at the job decided that the stays and several tubes would have to be removed, as we would run the risk of having a leak where stays come through the head.

I did not believe it was necessary to remove the stays to take them up. It was therefore decided, after writing to the Department of Labor and getting permission, to do the job as shown in the figure.

Measurements were taken to determine the position of the stays when they were straight, and wood blocks were cut the proper length to block them into place. A section of each stay about 6 in. long, near the front head, was heated to a cherry red with an acetylene torch. Then the blocks were forced into place, which caused the heated sections to enlarge in diameter. When the stays cooled, contraction of heated sections caused them to come up nice and tight, the blocks falling out of place.

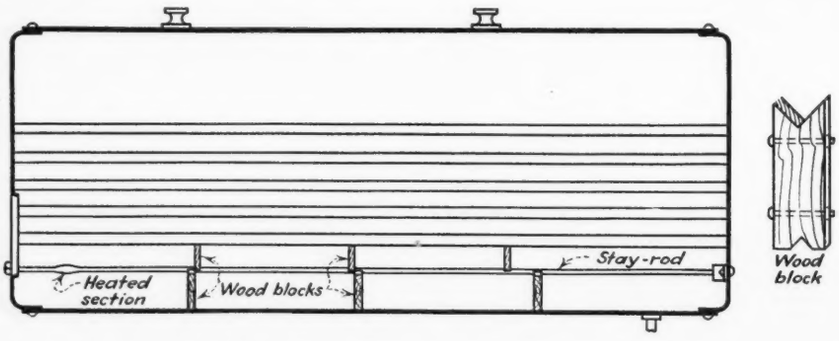
The job was completely successful and cost less than $5.00, saving about $150.00, which was the boilermaker's estimate for removing the rods without any leakage at the stay ends.

Fergus, Ont. H A CAMERON

Leaking Air Valves Cause High Temperature

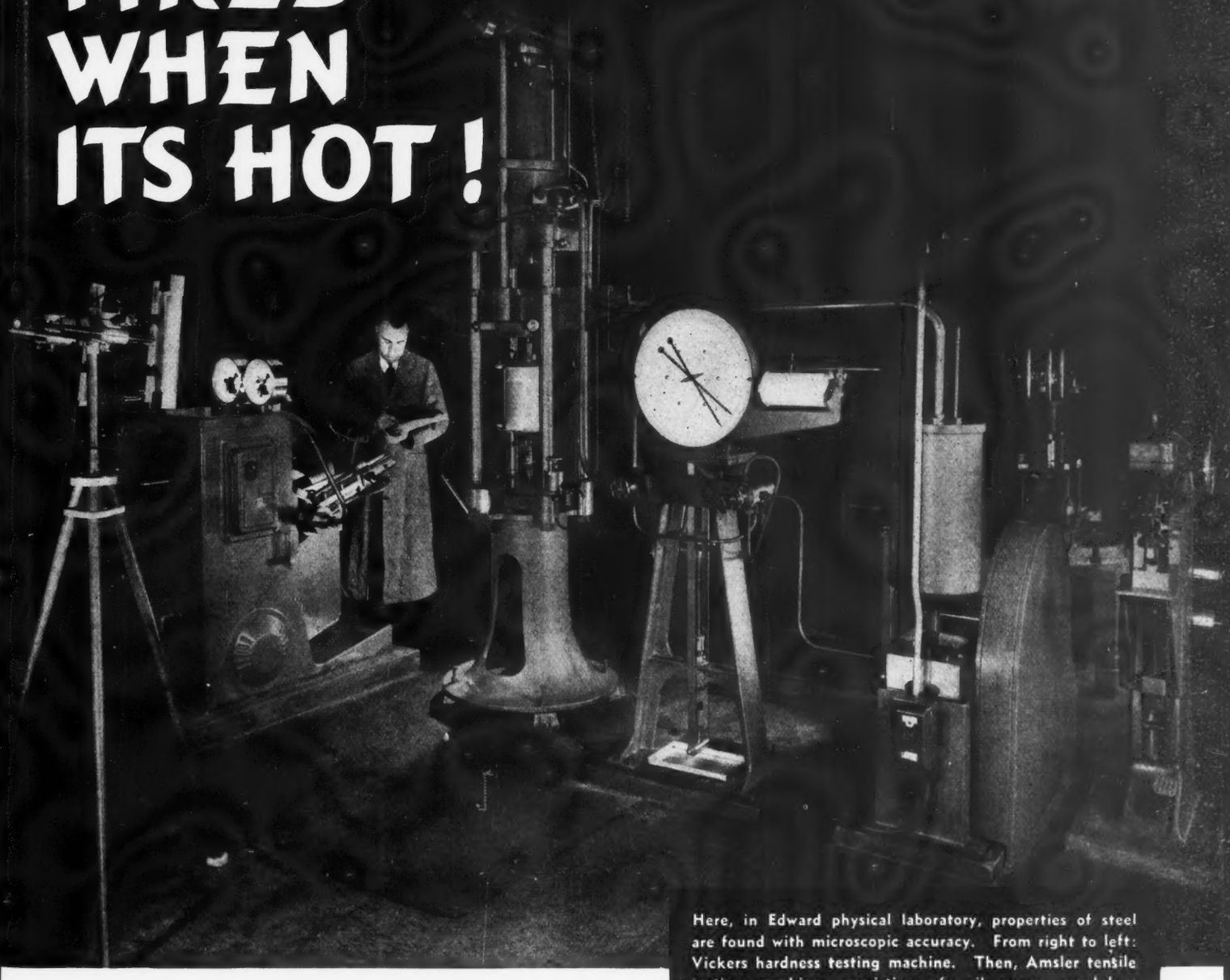
PROPONENTS of the leaky-discharge-valve hypothesis of compressed-air explosions score again. Some of the valve covers on one of our air compressors began to smoke. The engineer, after shutting down the machine and examining the valves, found leakage, made repairs and stopped the smoking. It was not the temperature of the air that caused the smoking, but the high temperature of the valve and the surrounding metal. This high temperature is produced by friction of air flowing through the leak. In this case, air was being compressed to two atmospheres, and the temperature increase for this pressure is about 115 F. Atmosphere temperature for that day was about 85 F so that the compressed-air temperature was around 200 F. But a temperature of 200 F would not make the valve covers smoke.

The rougher the passage through which the leakage air flows, the greater the friction and the more rapidly the temperature will rise, until it may reach ignition point of the oil. The fire then will travel in the direction of the air flow. If the heat



Choosing Materials for Edward Valves-No.5 of a Series

TIRED WHEN ITS HOT!



Here, in Edward physical laboratory, properties of steel are found with microscopic accuracy. From right to left: Vickers hardness testing machine. Then, Amsler tensile testing machine, consisting of: oil pump, pendulum dynamometer, testing machine itself, "pulsator" for "tiredness" tests at fluctuating loads under service temperatures, and Amsler-Martens extensometer (on tripod) for ultra-precision elongation measurement.

STEEL gets tired when it's hot. And we don't mean weather. It is the heat of operation—steam, oil, or what have you—that causes some steels to weaken faster than others. Steel stands up well, or not so well, in proportion to inherent qualities which are isolated, identified, and appraised by Edward technicians.

Edward valves are now being sold in far greater number than ever before—and Edward has always specialized in valves for severe service—for use under top heat and pressure. So Edward, more than ever, strives to use only materials that are exactly right.

Equipment in the Edward laboratories continues to stress the significance of tests over the entire temperature range at which the valves are to work.

Have you Edward material specifications guide No. A-10? It's yours for the asking.

• • •

THE EDWARD VALVE & MFG. CO., INC.
EAST CHICAGO INDIANA

Edward Valves

Stop · Check · Non-return · Blow-off · Feed Line · Relief · Bleeder Line · etc

could be conducted away fast enough, temperature would not rise to danger point, but when fire hose through which cold water flows at the rate of 250 gpm will catch fire, it is evident that in an air compressor a dangerous temperature is easily possible. A standing order in our plant is, that when valve covers smoke, shut down the machine, examine valves for leaks and correct the trouble. And it works.

Toronto, Ont. R McLaren

Mr. McLaren has, on previous occasions, advanced the theory that leaky discharge valves may be the cause of compressed-air fires and explosions. Other engineers have shown that recompression of the air in the compressor cylinders cannot raise its temperature to a value required to ignite oil. Apparently both are correct, but each is talking about a different result. Recompression of air leaking back into the cylinders through faulty discharge valves cannot raise the temperature to the ignition point of a good grade of lubricating oil. But, as Mr. McLaren points out, it is not the temperature of the air but that of the valves and surrounding metal that must be considered. Because of heat produced on the surface of the metal by friction of the air through a leaky valve, its temperature may become high enough to ignite the oil or carbon particles. Once ignited, most anything can happen, including a disastrous fire or explosion.—Editor

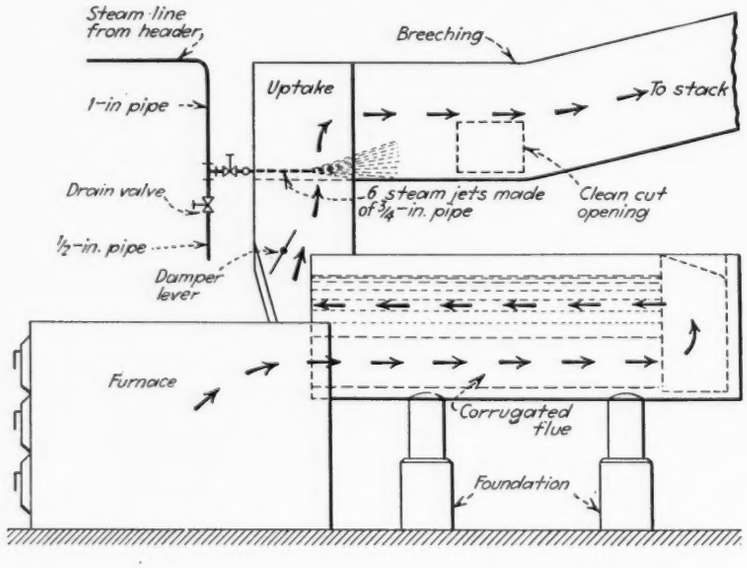
Steam Jets Remove Soot from Breechings

Accumulation of soot and non-combustible substances in the uptake connection and breechings caused inadequate capacity of flue-gas passages in the stack connection of a large building-heating boiler plant. The two boilers are Scotch marine type, arranged as shown in the figure, and connect into a common breeching 4.5x4.5 ft in cross section. The breeching is about 25 ft long from uptake to stack and has a rise of about 4 ft in that distance. Solids in the gas accumulated on the bottom of the breeching to a depth of 2 to 2.5 ft in a heating season.

It did not make any difference how the boilers were operated; solids accumulated in the breeching at about the same rate. Therefore, it was necessary to remove the seasonal accumulation each year to avoid draft loss and a dangerous condition due to weight of material in the breeching. Several methods were tried for removing this material, but removing it manually to the stack and taking it out through the cleanout door in the stack base was the only one that proved successful.

The plan shown in the figure to prevent soot accumulation in the breeching was tried and worked successfully. Six steam jets made of $\frac{3}{4}$-in. pipe were connected into a 1-in. header and placed close to the bottom of the breeching through holes in its front end. These jets connected by a 1-in. pipe to the main steam line and were provided with a $\frac{1}{2}$-in. drain. The drain permits blowing water out of the line before turning the steam into the jet. This insures dry steam for blowing the soot from the bottom of the breeching. For adequate cleaning of the breeching, jets are operated for a few minutes each day. Now, solids in the flue gas, instead of accumulating in the bottom of the breeching, are delivered to the stack where they can be easily removed through the cleanout door.

Chicago, Ill. Thomas J Brett



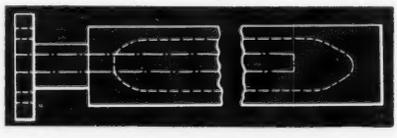
Expansion Chambers Reduce Vibration

Trouble was encountered in a large industrial plant because of vibration in the piping from two horizontal, single-stage air compressors rated 250 cfm at 100-lb pressure. It was difficult to keep supporting braces tight, and excessive vibration was transmitted to meters and other equipment through the building structure. After some experimenting, it was decided to place an expansion chamber on the discharge of each compressor. These were made from 5-ft sections of 14-in. extra-heavy pipe obtained from the salvage department.

Suitable flanges were welded on the ends of the pipe, and companion flanges made up, one for the discharge nozzle of each compressor and one fitted to the discharge air piping. The chambers were mounted in a vertical position directly over the compressors, and have completely eliminated the vibration in the air piping.

Traps were connected at the bottom of these expansion chambers to drain off condensation. Much of the oil and moisture is taken off at this point, which formerly went into the receivers, giving less condensation there and consequently drier air is supplied to the plant.

New York, N. Y. R. C. Larkins

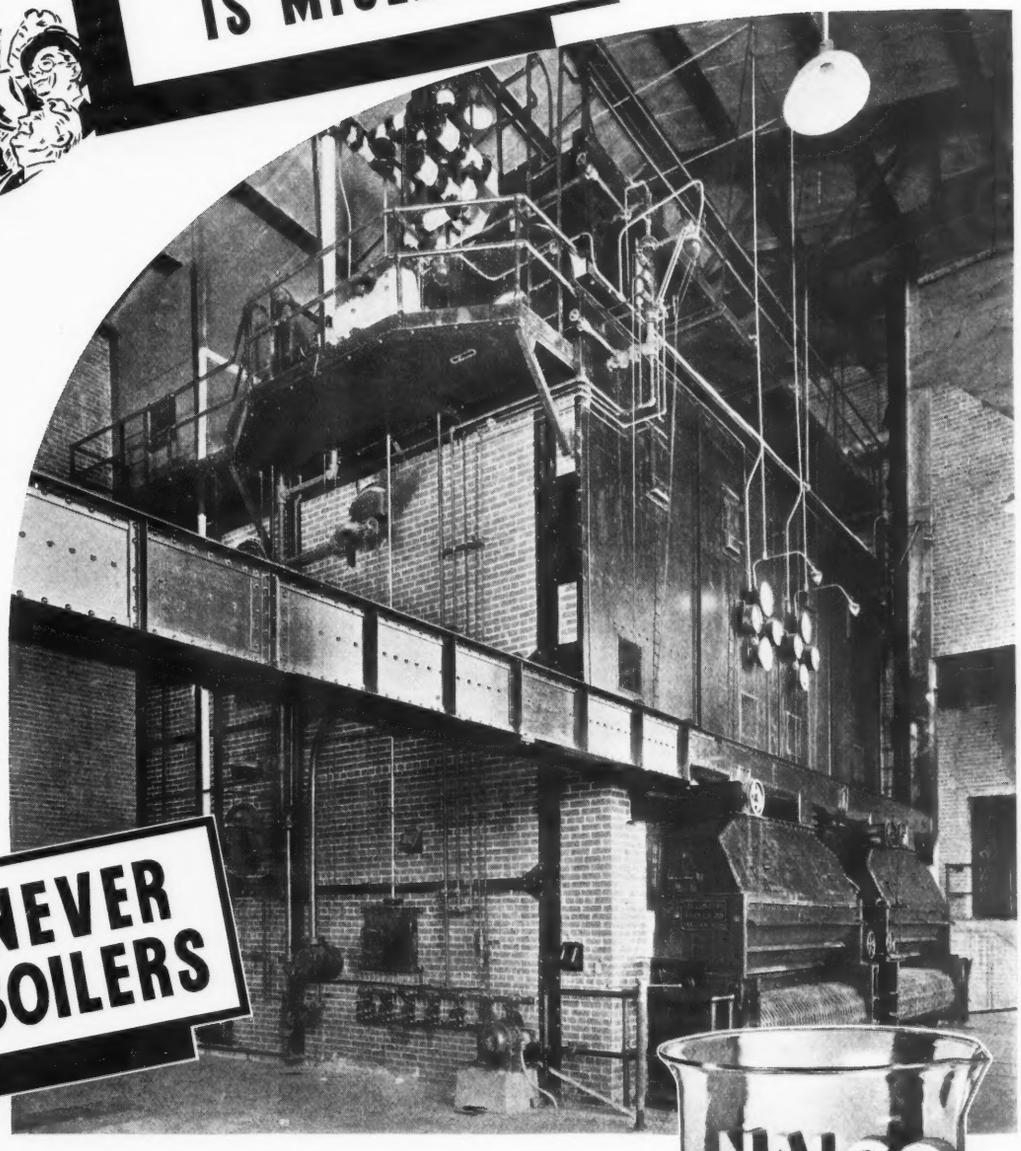


Reduced Plunger Weight Cures Crosshead Pound

With approximately 15,000 hours of pumping against 700-lb pressure to its credit, a battery of three triplex, 6x24-in. plunger pumps began to pound at a time in their work cycle which should not denote unusual strain. The pound occurred when each crosshead plunger reached the end of travel on the pumping stroke, and reversed to begin suction. As the noise seemed to be in or at the crosshead, the clearance between both lower and upper shoes with their respective slides was checked and set at 0.002 in. This close adjustment almost eliminated noise, but, being too close for normal operation, was discarded in favor of former tolerances.

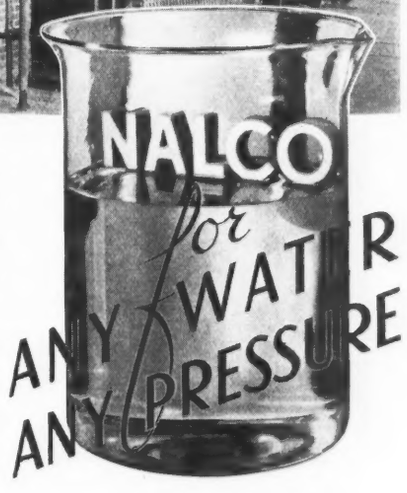
When the diesel driving one of these pumps was next down for repairs, a plunger was pulled and carefully "miked." A wear of 0.006 to 0.008 in. was found where the plunger travelled within the packing. This

OFTEN, THE CROWD IS MISLEAD-



BUT NEVER YOUR BOILERS

THE real test of anything is what it will do in service. When it comes to feedwater treating, the best judges possible are your own boilers. What they can tell you about the Nalco System of Feedwater Treatment will, in a large measure, explain why a very high percentage of all original users of Nalco service continue to be enthusiastic customers year after year. It's easy to demonstrate this to your own satisfaction. Adoption of the Nalco System requires no capital investment. Our engineers will be glad to make a survey of your requirements. No obligation.



NATIONAL ALUMINATE CORPORATION

6222 W. 66th Place **Chicago, Illinois**

Inquiries other than domestic, *except those from U. S. Possessions, Canada and Mexico,* should be addressed to ALFLOC LTD., Bush House, Aldwych, London, W. C. 2, England. Canadian inquiries should be sent to ALUMINATE CHEMICALS LTD., 372 Bay Street, Toronto, Ontario.

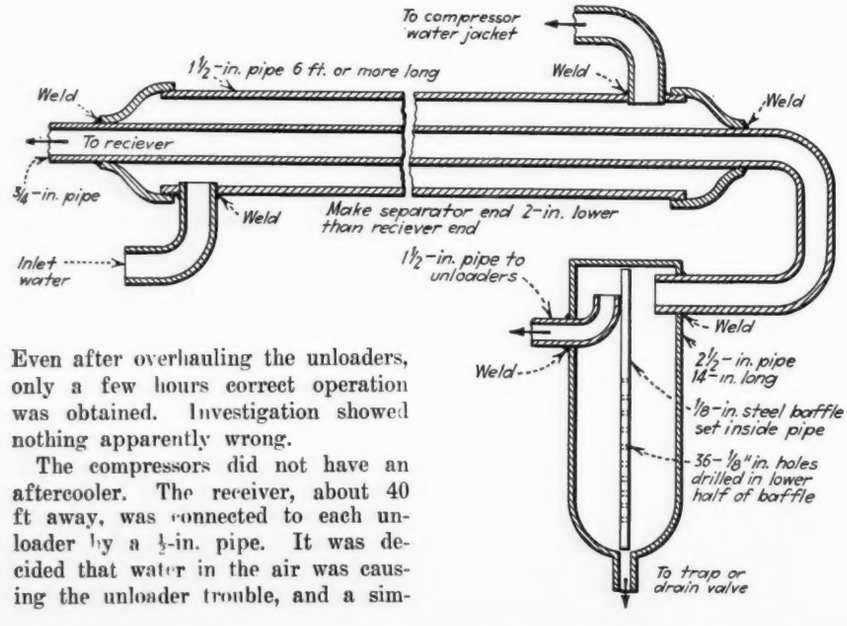
led to the theory that while under pressure, the packing supported the plunger throughout its travel. When the 700-lb working pressure changed to 10- or 12-lb suction, the packing released the plungers which fell through the clearance and acted as a lever to throw the crossheads against the slides.

Except for 1.75-in. axial holes to within 7 in. of their pressure ends, plungers were solid. To reduce the pounding, the plungers were taken to the shop and bored out (see figure). The dot-and-dash lines show the original cored hole, which was enlarged as indicated by the dotted lines, leaving the walls 1 in. thick. After installing the remodeled plungers, the pump was put on the line. Pounding was almost entirely eliminated, even when the upper crosshead shoe was backed off to increase clearance. The bored plungers also increased packing life from 2 to 6 months and did not tend to run hot. Packing wear, instead of being concentrated on the lower section of the stuffing box is now evenly distributed around the full circle.

Kilgore, Texas CHARLES S LYNDE

Correcting Faulty Air Compressors

Two 750-cfm, 2-stage, 110-lb, motor-driven air compressors in an industrial plant gave constant trouble. Maintenance was high, valve plates and springs lasting only 5 or 6 weeks. Power consumption was excessive. It was found that unloaders were not working properly, and testimony of operators was that they had never worked for any considerable time.



Even after overhauling the unloaders, only a few hours correct operation was obtained. Investigation showed nothing apparently wrong.

The compressors did not have an aftercooler. The receiver, about 40 ft away, was connected to each unloader by a ½-in. pipe. It was decided that water in the air was causing the unloader trouble, and a simple aftercooler and separator was made and installed, as in the figure. This completely eliminated trouble with the unloaders.

A relief valve had been put in the high-pressure line about 3 ft from one compressor. This valve popped due to line surges when that compressor was running, and the receiver pressure was about 8 lb below that at which it popped, if only the other compressor was running. Placing the relief valve at the receiver stopped all the noise it had made, and effective air pressure in the receiver was increased 8 lb.

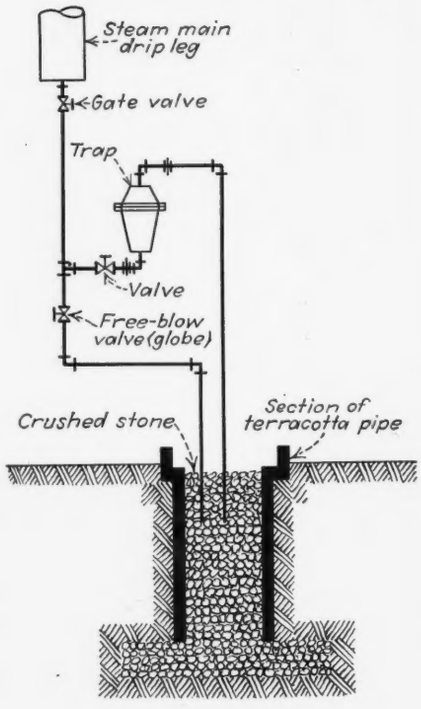
To further reduce repairs, injection of soap solution into the compressors each week was initiated. Castile soap was first used, but was discarded for strong washing powder, which more than doubled valve life. Valve-plate failures changed from warping to grooving. The grooved plates were faced off on a surface grinder having a magnetic chuck, which gave us about 75% of the life of new plates.

Results obtained from these changes greatly reduced repairs and power consumption dropped 7,000 kw per month, which alone amounted to a saving of $140 each month.

Radford, Va. GEORGE R ELDER

Disposal of Outside Trap Discharges

STEAM flowing through modern distribution piping is frequently slightly superheated to avoid excessive condensation and other losses. For this reason, drainage traps discharge infrequently and it is often found uneconomical to recover the small quantity of condensate. Discharge lines from



outdoor traps are then piped to some point on the ground in the immediate vicinity, but there is always the hazard of scalding someone with the hot discharge, soil may wear away gradually to form a depression in which water accumulates, ground may weaken under foundations of structural-steel pipeline supports, and ice forms during extremely cold weather.

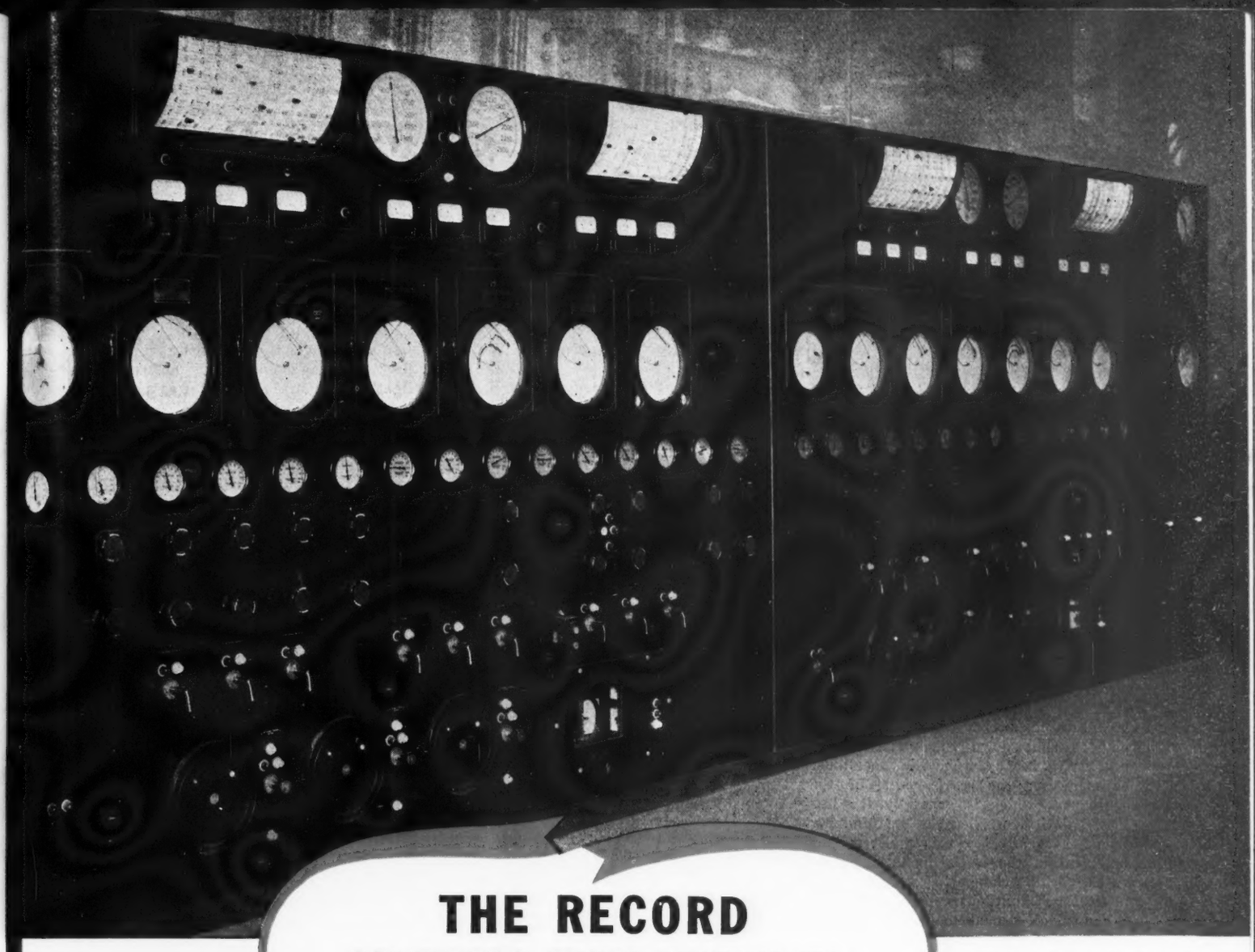
To avoid these difficulties and to permit landscaping at one large industrial plant, all non-recoverable outside traps are discharged into sunken sections of large diameter terracotta or concrete drainage pipe. The pipe is buried to the bell and then filled with crushed stone. In some instances, especially where considerable amounts of water must be handled or where sub-soil is relatively impervious to moisture, a layer of stone is placed underground over an area of several square feet around the bottom end of the pipe.

Richmond, Va. C R ANDERSON

Oil and Insulation Are Poor Bed Fellows

PROTECT insulation of electrical machines against oil. Experience shows that from 50 to 90% of motor-winding failures are caused by oil getting on the insulation. Anti-friction and some types of sleeve bearings are designed to keep oil in and dirt out. These bearings have done much to prevent winding failures.

Ordinary sleeve bearings require attention to prevent oil from getting out of them.



THE RECORD SPEAKS FOR ITSELF!

Hagan Automatic Control Panel for the first two of three new 600,000 lb. per hour—1250 lb. pressure boilers at Springdale Station.

This Hagan Control is the nerve center of an investment totalling millions of dollars!

IN 1920, when the first unit of West Penn Power Company's Springdale Station was built, the boilers were equipped with Hagan Control. In 1923, when an extension to the plant was installed—again Hagan Control. In 1937, a program involving the installation of a 50,000 kilowatt top turbine with high pressure boilers brought the third order—the modern automatic control installation pictured above. The record speaks for itself!

Ninety percent of Hagan Control users re-order—why? Because they find by satisfying experience that Hagan Control is rugged, simple, accurate, fast, stable and reliable. And above all that, it is *not* automatic "in name only"—*it works automatically all of the time.*

HAGAN CORPORATION
300 ROSS STREET, PITTSBURGH, PA.

HAGAN AUTOMATIC COMBUSTION CONTROL

The Pioneer - and still the leader

CURRENT COMMENT

Diesel Plants in New York

MY ATTENTION has been called to the full-page advertisement which the Consolidated Edison Company of New York ran in the New York "Daily News" late in October. This listed, by name, private plants which have recently been shut down in New York because, so the advertisement inferred, it was found cheaper to return to purchased current. At least one of the listed plants was a recent installation, shut down very shortly after installation.

I could not, of course, presume to investigate all of these plants, but the apparent facts regarding one, that at Sailor's Snug Harbor, are such as to cast suspicion on the integrity of the entire advertisement.

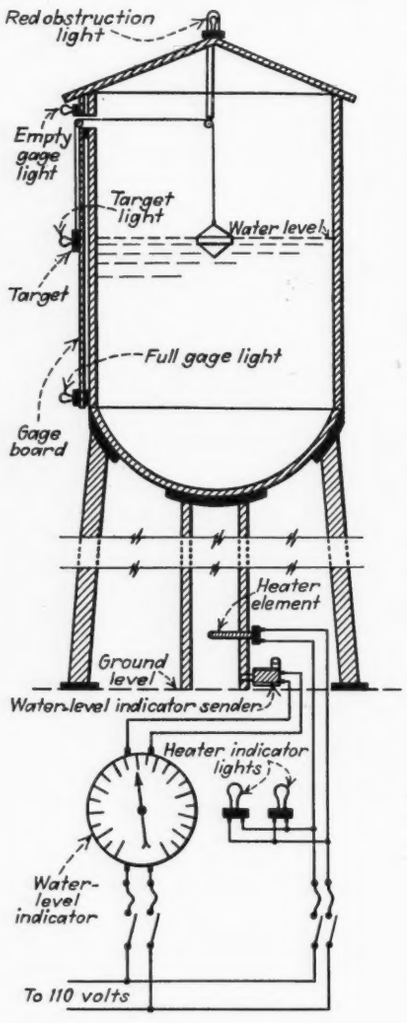
A new diesel plant should not be installed unless the total cost of its output, including fixed charges, is less than that of purchased power. With the plant once installed, cost of purchased power must fall practically to the operating costs of the diesel plant, *not* including fixed charges, before it will pay to shut down the plant. I say *practically*, because some allowance must be made for the resale value of the equipment, which is generally far less than half its installed cost. It follows, then, that only an extreme error of judgment in the initial installation, or an astonishing change in conditions, can justify such shutdowns.

The advertisement makes no mention of a cash consideration for the plant itself. If there were no cash consideration, it is difficult for me to understand what could possibly have motivated the trustees of Sailor's Snug Harbor to abandon the plant. And if there were a cash consideration, the advertisement is misleading. Or can it be, as some have suggested, that installation of the diesel plant led to the discovery, by the utility, of an available rate schedule which cut the pre-diesel monthly power bill more than 50%.

I happen to know that such questions as these are being asked privately by many engineers in the vicinity of New York, and feel that the publication of an explanatory statement would be of interest to all concerned.

In plain English, the questions to be answered are: How many of the listed plants were shut down purely on the basis of the true relative economies of diesel power and of purchased power? In what cases were more favorable power-rate classifications made available after the installation of diesels? In what cases, if any, were there other considerations such as the direct or indirect purchase of the power plant by the utility? If plants were purchased, was the later disposition of the equipment such as to indicate a bonafide purchase for reuse or for resale without loss?

New York, N. Y. HUXLEY MADEHEIM



Pilot Lights on Tank-Gage Target

I HAVE read the short article "Lamp Installed on Tank-Gage Target" in October *Power*. This description brings to mind a similar device incorporated in a much more elaborate system of water-level indication installed on the service-water tank of a large industrial plant. Some of the features used on this installation may be of interest.

This tank maintains head on the plant's fire-protection system and serves as an emergency course of boiler feedwater. Because of this dual function, responsibility for maintaining water level is assigned to the power-plant operators. The tank, while visible from the power-plant windows, is located some distance away, but the booster pump used for filling is in the power plant. Most of the control valves are in a pit at the base of the structural steel supporting the tank.

Water level is indicated by the usual target and gage board and a remote-indicating water-level meter. While the target and gage are easily seen during the day, a light on the target is needed at night. This light, however, does not furnish enough illumination for identification of gage markings, so lights are installed at the top and bottom of the gage board and water level is approximated by observing the position of the target in relation to these lights. Other tank lighting includes flood lighting and a red obstruction light placed on the tank roof as a warning to low-flying aircraft.

Foggy weather, and the target sticking due to ice formations on the outside of the tank during the winter months, impose limitations on the reliability of the target and gage. For this reason a remote water-level meter was provided. Measurements from this instrument are transmitted electrically to a dial indicator calibrated in terms of tank capacity. This indicator is located on a control board in the power plant.

Because of favorable geographic location, very little difficulty is experienced with freezing of the water inside the tank. An electrical heater affords protection against internal ice, even in the most extreme weather. This heater is controlled by a switch in the power plant. As shown in the diagram, the heater circuit is equipped with duplicate low-wattage pilot lights so that the operators know at all times whether or not the circuit is energized. These pilots have been instrumental in eliminating much current waste formerly caused by the heater being in service when not needed.

Roanoke, Va. S H COLEMAN

Colloidal College—I

(To Philip Swain, Editor of *Power*)

On page 540 of the Mid-September issue of *Power*, in an article entitled "Industrial Trends," under a sub-title "Feedwater," appears the statement—"Water treatment is still in a state of flux. Much is heard of colloidal treatment, for example, but little information is available in simple, understandable terms."

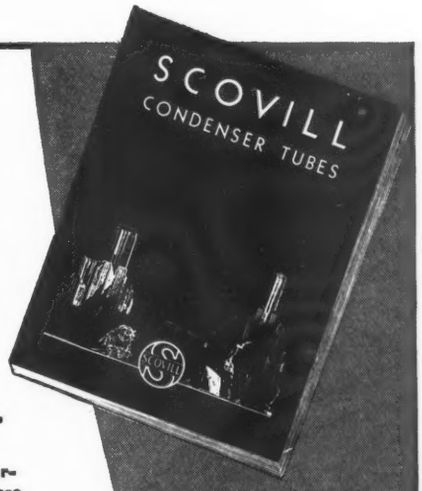
Our laboratory having conducted what is probably the greatest amount of research in the field of reactive colloids, I feel that I am called upon to enlighten you somewhat in this work.

Having had the privilege of meeting you personally on several occasions, I well know your desire to seek the truth, and I further know the thorough and analytical manner in which you usually conduct your investigations into a study of a given subject.

You are perfectly correct in your statement that "much is heard of colloidal treatment," and I might add that much is being done in the use of colloids, particularly of the reactive type, in the solution of water-conditioning problems. I am sure you did not intend to convey the idea that the use of colloids in the chemistry of water

10 CONDENSER TUBE ALLOYS

—AND THEIR APPLICATIONS



Disregarding many individual cases, for a combination of various corrosive conditions make exceptions necessary, we present the following list of Scovill tube alloys and a few of their applications:

- **MUNTZ METAL**—Applicable to steam condensers and other low-temperature, low-pressure heat exchangers.
- **COPPER**—Suggested for steam condensers where fresh water is used, and particularly with relatively soft waters carrying high concentration of dissolved gases (CO_2 and O_2).
- **ARSENICAL COPPER**—Essentially the same uses as those of formerly used standard types of commercially pure copper. The addition of Arsenic raises its softening temperature appreciably so that it can be used in heat exchangers operating at temperatures up to 300° C.
- **RED BRASS**—Applicable to condensers and heat exchangers where it is necessary to combat "dezincification," and where acidity, if any, is of a low order.
- **ADMIRALTY** (extruded or cup drawn)—Applicable to condensers and other heat exchangers where raw water—whether fresh, brackish or saline, pure or polluted—ranges from moderately acid to alkaline.
- **ALUMINUM BRASS**—Principal uses and best performances have been in the marine field and tide-water plants where saline waters are encountered.
- **ALCUNIC**—Has a superior resistance where there exists a combination of impingement attack and "dezincification."
- **CUPRO-NICKEL** (80-20)—This alloy is economically applicable for severe service in salt or contaminated waters—at relatively high temperatures and under conditions imposing erosion as well as corrosion.
- **CUPRO-NICKEL** (70-30)—This alloy possesses properties similar to the 80-20, but is even more highly corrosion-resistant.
- **ADNIC**—A superior corrosion-resistant alloy recommended for the most severe conditions under which copper alloys are serviceable.

A new 48-page, fully illustrated book, featuring methods of production, selection of material, specifications for various alloys and installation methods, is now available. It will be sent upon request to purchasing agents or engineers interested in the technical side of condenser tubes. Write to the Scovill Manufacturing Company, 13 Mill Street, Waterbury, Connecticut.

SCOVILL MANUFACTURING COMPANY

WATERBURY **CONNECTICUT**

SCOVILL CONDENSER TUBES PROVE DEPENDABLE SCOVILL

conditioning is surrounded by deep mystery. I know of no organization which has released more publications on this one subject than the Betz Laboratories. We have actually conducted classes of instruction on this very subject in Philadelphia, Newark, Baltimore, Chicago and other cities—one lecture of which I know you personally attended.

I am taking the liberty of forwarding you with this letter several publications on this subject written by members of the Betz personnel. If we can enlighten you to any further extent, or if we can remove any of the shroud of darkness that seems to exist in your mind, we would certainly appreciate your suggestions.

The use of reactive colloids has definitely proved its place in the field of water purification, and the Betz organization will continue to enlighten interested parties through all available sources.

Philadelphia, Pa. L D BETZ

I admit that I have not kept up to the minute on colloids. Nor have I yet found time to study the publications submitted by Mr. Betz. Therefore, no extended comment at this time and place would be worth while. Later I may have something to say and, meanwhile, shall keep an open mind on the subject. In fairness to Mr. Betz it must be stated that some of the publications submitted seem to be written in simple language, although others do tend to use those $5 words which are such an effective barrier between the minds of chemists and us plain mechanics. While waiting around for the editor to polish up his personal education, some of the users without commercial interest in the sale of colloidal materials might care to get into the argument. Within reasonable limits of space these pages are open.—EDITOR.

Colloidal College—II

In Mid-September *Power*, page 540, this statement appears under *Feedwater:* "Water treatment is still in a state of flux. Much is heard of colloidal treatment, for example, but little information is available in simple understandable terms."

In this connection I would like to point out that, as far back as 1886, research showed that calcium, aluminum, barium, strontium and iron in the presence of a certain nitrogenous organic colloid will be precipitated from solution in a gelatinous form, which suggested its use to prevent boiler incrustation. About 1924, Dr. Freundlich, an eminent chemist, stressed the use of colloids for boiler water.

Not all colloids are suitable for boiler-water treatment, and the success of one type that cannot be analyzed because of its complex structure, has caused an influx on the market of many colloids that are valueless for boiler water, particularly at high temperatures.

Some venders of softening and chemical treatments may have retarded the advancement of this important science by advising the client that there is no way to determine by chemical formula how much of the colloid to use. This is just as true of ordinary chemicals. All chemical equations are based on the reactions of the chemicals considered as reacting in distilled water only, with no interference from other solids, always found in boiler water. It is always necessary to use an excess of chemicals over the theoretical amount to obtain a complete reaction.

Colloids, on the other hand, might be considered as working directly opposite to the manner in which chemicals perform; in the presence of other solids (within reason) the speed of their reaction and control of scale is increased.

The action of a colloid in boiler water is three-fold: chemical, electrical, and mechanical.

(1) There is first a slight chemical reaction with those portions of the scale-forming salts that are in solution, which precipitate as a gel.

(2) Because the solubility of the scale salts decreases with the increase of the boiler temperature in the process of precipitation, these scale salts pass through the colloidal state* and are mutually attracted to this negatively charged colloid, and converted into a gel also, so that the scale salts never reach the crystalline state to coalesce and form hard deposits.

(3) The gels so formed contain about 98% water, while in water, so that they cannot adhere to the heating surfaces. They do, however, circulate in the boiler and with a sponge-like action absorb all the suspended matter they contact and eventually gravitate to a point to be removed by blowing.

Because they combine easily with the scale salts when they are in this concentrated colloidal state, a very small amount of colloidal material is required.

Here's a comparison with chemical treatment: Where the theoretical amount of disodium phosphate required for 1 lb. of calcium carbonate hardness is 1.4 lb. (but in practice more nearly 3½ lb.) only 1/80 of a lb. of this colloid is required to do the same work.

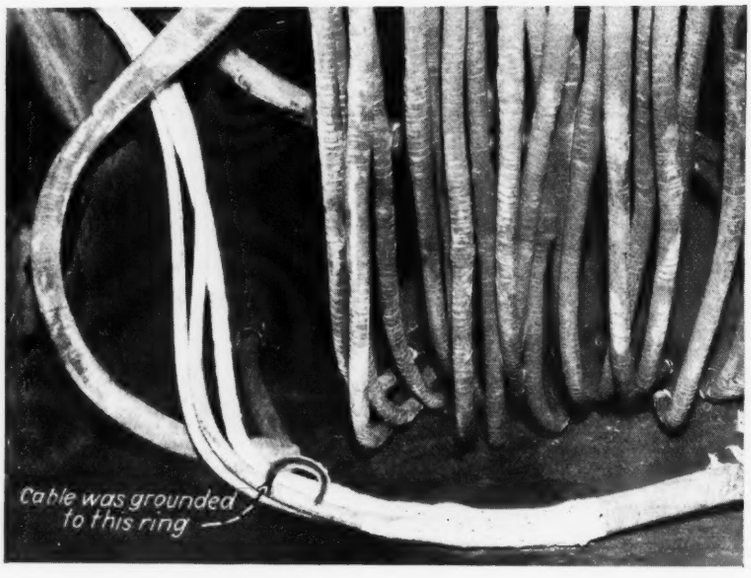
It is obvious, therfore, that the saving in blowdown by colloidal treatment will pay for itself many times over. Colloidal treatment can be applied without special apparatus and as remote from the boiler as convenient, and thus also prevent corrosion in the feed lines, heaters, and economizers, as well as in the boilers, and prevent the occurrence of precipitation in any of these places.

Boston, Mass. H R MCCURTAIN
Aquasol Co

Wrapped Cables Confine Fire

TO MINIMIZE the spread of arcing fires resulting from grounds and short-circuits in old cables not provided initially with flame-resistant coverings, mentioned by J M Myers on page 642, October *Power*, the Associated Factory Mutual Fire Insurance Cos, Boston, recommend wrapping each cable with 2-in. asbestos tape applied with a 50% lap, and then thoroughly saturating with a thin solution (sp. gr. 1.15) of silicate of soda. In a Tennessee plant where this was done on recommendation of one of Factory Mutual's inspectors, cable insulation became abraded and grounded where it entered a conduit, breaking down one night. The arc ignited the insulation. The watchman discovered the fire, called the chief engineer, and a new cable was promptly installed without interruption of service the next morning. The photograph shows how the other wrapped cables in the manhole escaped injury. Whenever feasible, the insurance engineers advise purchasing cables with flame-retardant coverings, but in view of the many old installations where this cannot be done, the wrapping method is advocated for general use.

Boston, Mass. H S KNOWLTON



* A colloid is a particle of matter that has been reduced in size so that it ranges in dimension between super-molecular size and 1/7,000,000 millimeter. Matter in a colloidal state may have either a positive or negative charge, or be neutral.

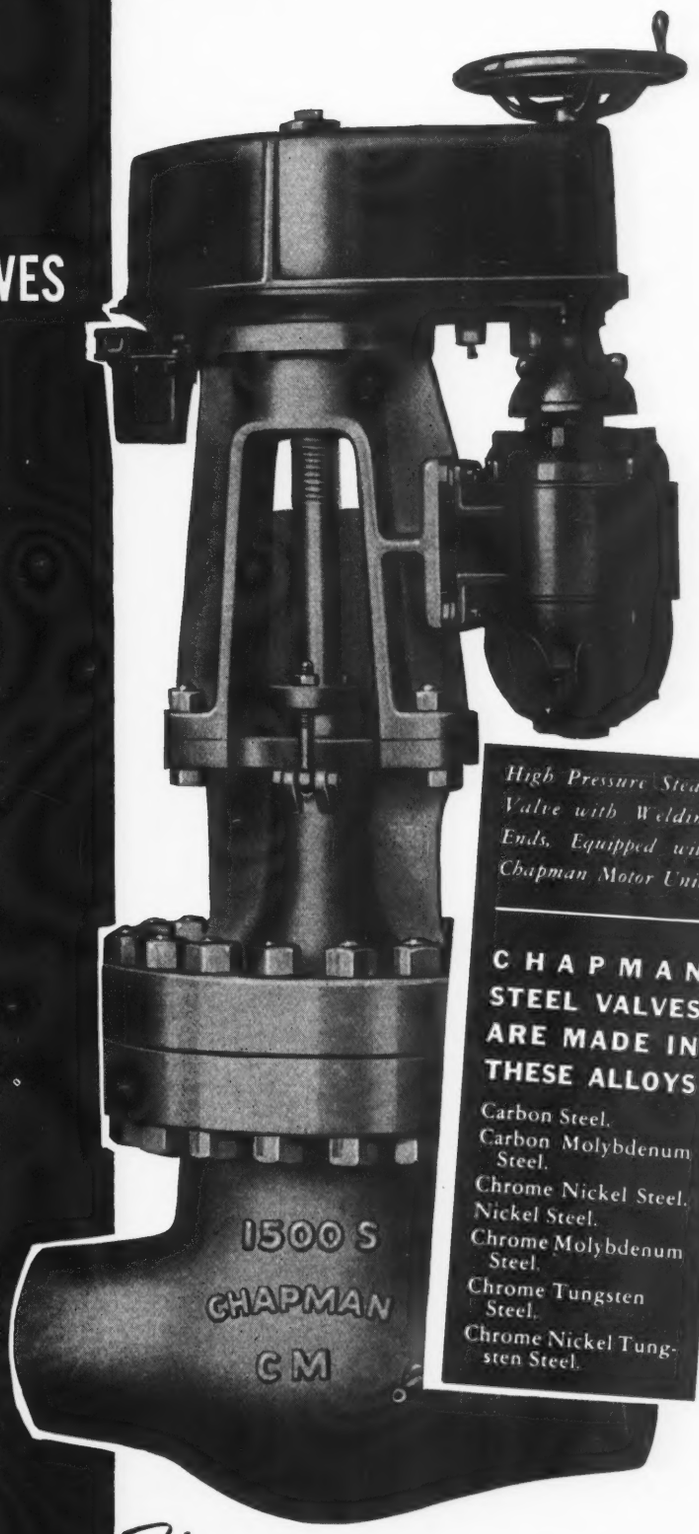
Chapman

BUILDS POWER PLANT VALVES THIS WAY

Right from the start, Chapman *borrows* trouble in making power plant valves to eliminate trouble in service. Chapman shops the country over for top quality in raw materials. Their metallurgical engineers supervise—and double-check—every pound of steel melted in special electric furnaces, in Chapman's own foundries. Then strength-tested castings are turned over to master machine-craftsmen who work to decimals that *predetermine* permanent accuracy.

All this means extra time and trouble—but it means valves that you can count on for long years of trouble-free service under today's high temperatures and pressures.

You can obtain this premium quality in valves of any type . . . in any of the steels listed . . . that you may need in any branch of plant operation. Equipped with any type of operating mechanism. Ask for full information and prices.



High Pressure Steam Valve with Welding Ends, Equipped with Chapman Motor Unit.

CHAPMAN STEEL VALVES ARE MADE IN THESE ALLOYS

Carbon Steel.
Carbon Molybdenum Steel.
Chrome Nickel Steel.
Nickel Steel.
Chrome Molybdenum Steel.
Chrome Tungsten Steel.
Chrome Nickel Tungsten Steel.

The

CHAPMAN VALVE

MANUFACTURING COMPANY

INDIAN ORCHARD, MASSACHUSETTS, U. S. A.

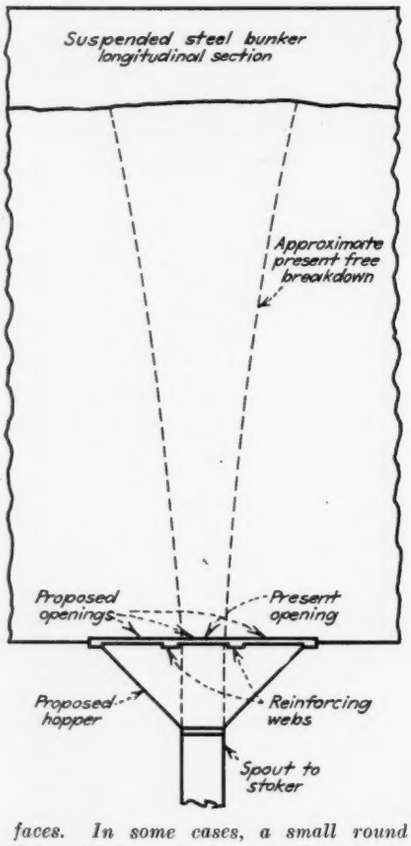
READERS' PROBLEMS

QUESTIONS for Our Readers

Coal-Bunker Outlet

Question 1

WE HAVE *a large bunker for overhead storage of coal with down spouts leading to individual stokers. We use a steam coal graded 1½ in. and under. Often this coal is predominately fine and when shipped in rainy weather or when outside temperature is below freezing, coal in the bunker has been known to stand with almost vertical*



faces. In some cases, a small round hole will drop all the way through the 20-ft depth of coal in the bunker. In any event, coal flow is interrupted and the fireman has to use hand methods to reestablish coal flow.

The first shift engineer has suggested an elongated hopper to replace the single 12-in. outlet opening. This hopper would have three 18 x 18-in. openings to the bunker. Stresses in the steel bunker plate would be taken up by welding a heavy webbed-steel plate which would be the attachment plate between hopper and bunker. And instead of having a single outlet opening in the bottom of the bunker, there would be three such openings in line, which would have a tendency to avoid a cylindrical hole and its tendency for coal arching. Before investing money in this proposed revision, I thought that Power *readers might be able to help us with a problem that is very aggravating a few weeks each year.*—HHL

Motor-Generator Set

Question 2

A MOTOR-GENERATOR *set, made up of a 130-volt dc shunt generator direct connected to a 3-phase, 25-cycle, 220-volt induction motor, has been acting up on me. When any voltage drop or line trouble occurs, the set will blow the dc fuses. Also, if excitation be reduced so that the battery is discharging, and if the dc-generator switch is pulled and then thrown in, the generator will show a charge of 10 amps and excitation is similar to that with a discharge current. Apparently, polarity is being reversed when a line interruption occurs, which causes the generator to become a motor and blow the fuses. Why aren't fuses blown on low excitation and when the dc switch is pulled? Is the generator oversensitive? Would shifting the brushes overcome the trouble?*—LHK

Suitable answers from readers will be paid for if space is available for publication.

BABBITTING A BEARING

Answers to October Question 1

The Question

I WOULD *like to know how to babbitt a main bearing (8 in. in diameter) on a horizontal ammonia compressor. The bearing, of a 4-part design, must be poured in place on the shaft. Because the crankshaft hub is close to one side of the bearing pedestal and a collar is shrunk on the shaft on the other side, bearing sections cannot be taken out endwise. There is just enough clearance above the flywheel to permit raising the shaft sufficiently to roll out the bottom quarter of the bearing.*

I do not like to pour hot babbitt on one side of a cold shaft but I can find no way of heating the shaft uniformly, as it cannot be revolved while heating. Since the room temperature is around 100 F, preheating the shaft may not be necessary. Heating the shaft on one side might spring it.

I could pour the bottom quarter of the bearing first and then pour the side quarters, with the wedges in place. No shims or liners are used between side and bottom quarters. It seems to me that if cardboard or similar liners are used to keep the metal from running past the shaft when pouring the side quarters, equivalent metal shims will have to be placed permanently in the bearing. Should the top quarter of the bearing be poured in position or on a mandrel?—AGH

Why Not Install a New Bearing?

BEST practice is to order new bearings from the factory, as the manufacturer knows the correct mixture for different pressures and speeds. Pouring a bearing around a shaft should only be done in an emergency, or when the shaft is badly worn or bearings are not removable.

However, if AGH still wants to babbitt, here's how it's done: First, make a mandrel with a diameter 0.25 to 0.5 in. smaller than the shaft. Set the mandrel on end on a smooth surface and clamp the bearing shell around it, using pasteboard shims for spacing the parts. Shims should project into the space between the shell and mandrel and almost touch the shaft, providing space for a thin connecting link of metal when the bearing is poured. The shell should be well tinned. Heat the shell and mandrel before pouring the metal. After the bearing cools, it can be removed from the mandrel, clamped together again and bored out to a size slightly smaller than the shaft. This allows some metal for scraping to fit on the shaft. Pour all metal at one time to get a good bond.

Back to my original point—all this trouble can be avoided by ordering a new bearing that will fit with only a small amount of scraping.

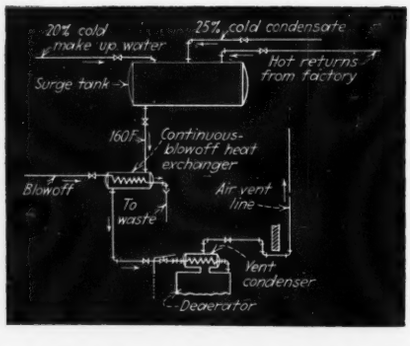
Walthill, Neb W W DINGWALL

How to Pour a Bearing in Place

THERE ARE several methods that can be used to babbitt the main bearing described by AGH. From his description, it appears that the only problem that puzzles him is: How to pour the side

WHAT'S WRONG WITH THIS PICTURE?—XXII

Surge Tank, Continuous Blow-Off Heat Exchanger and Vent-Condenser Piping



At least 14 errors are shown in this drawing. Make a list of those you recognize, then compare with the list on page 778

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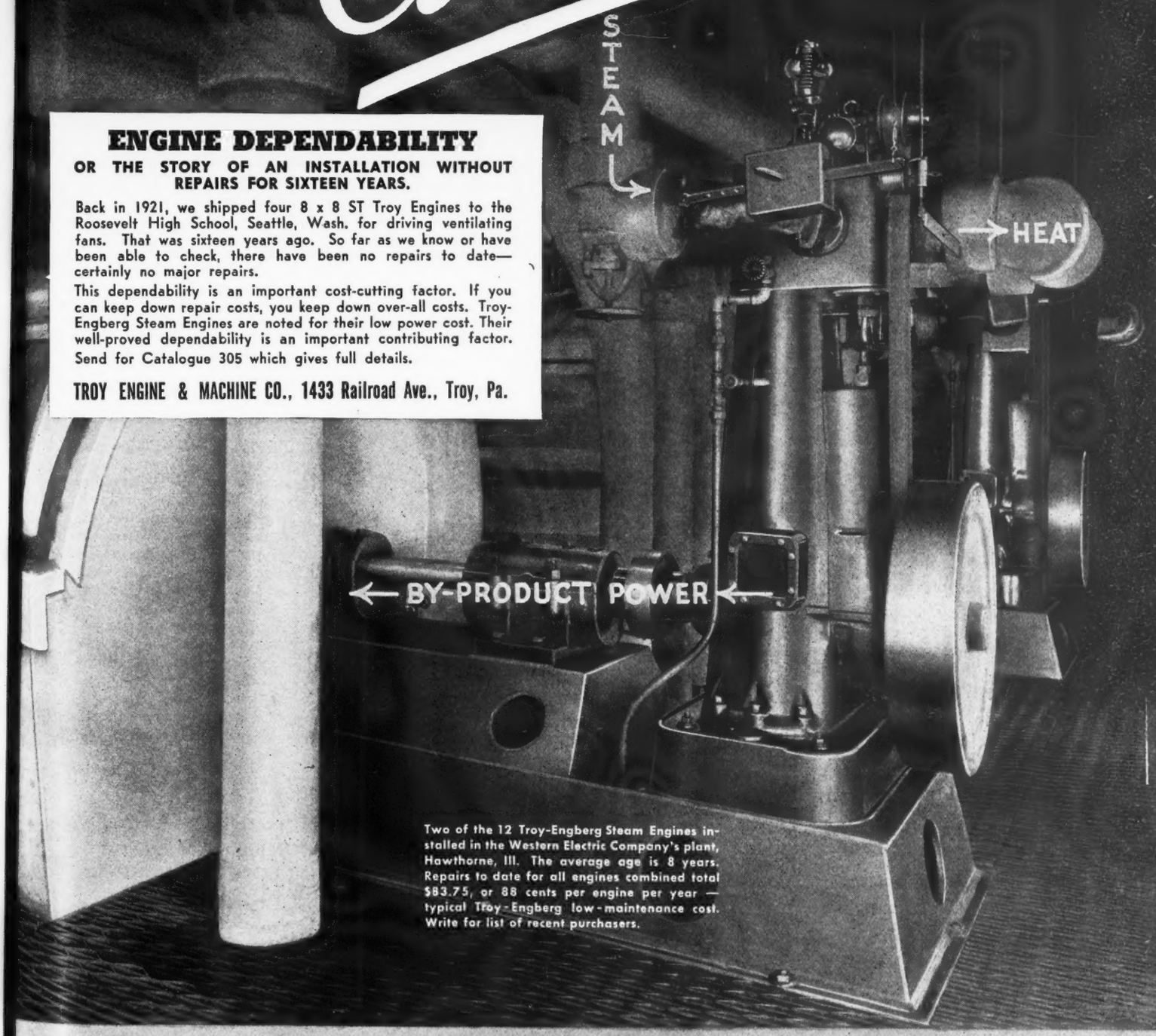
OR THE STORY OF AN INSTALLATION WITHOUT REPAIRS FOR SIXTEEN YEARS.

Back in 1921, we shipped four 8 x 8 ST Troy Engines to the Roosevelt High School, Seattle, Wash. for driving ventilating fans. That was sixteen years ago. So far as we know or have been able to check, there have been no repairs to date—certainly no major repairs.

This dependability is an important cost-cutting factor. If you can keep down repair costs, you keep down over-all costs. Troy-Engberg Steam Engines are noted for their low power cost. Their well-proved dependability is an important contributing factor.

Send for Catalogue 305 which gives full details.

TROY ENGINE & MACHINE CO., 1433 Railroad Ave., Troy, Pa.



Two of the 12 Troy-Engberg Steam Engines installed in the Western Electric Company's plant, Hawthorne, Ill. The average age is 8 years. Repairs to date for all engines combined total $83.75, or 88 cents per engine per year — typical Troy-Engberg low-maintenance cost. Write for list of recent purchasers.

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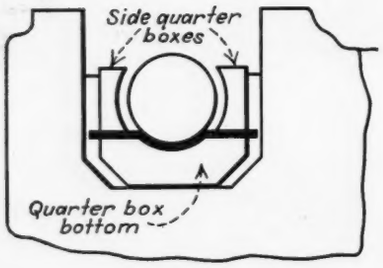

quarters? He suggests that if shims or liners are used under the side quarters, when shims are removed, the side quarter will not go down onto the bottom quarter. This is correct.

This difficulty can be overcome by jacking up the shaft, which permits the liner or shim to be slid under the shaft, as in the figure. The shaft will then be the same distance above the bottom quarter as the thickness of the liner. Likewise, quarter boxes resting on this liner will be the same distance above the bottom quarter. The outboard-bearing end of the shaft should also be raised the same amount, so that when the babbit is poured, quarter boxes will be poured in correct alignment. After pouring these quarter boxes, liners are removed, the shaft lowered into position and the side quarters scraped to fit.

A second method which will give a perfect result is to remove all four quarters and all old babbitt, and prepare the quarter boxes for pouring. A much better pour can be obtained when boxes of this type are poured from the end. By turning a mandrel about 0.5 in. smaller than the actual diameter of the shaft, there is left after pouring material for peening the babbitt back into the quarter boxes. Then they can be assembled in correct relation to each other, either in a lathe or on a vertical boring mill, and bored out to correct size.

Hartford, Conn. H W BENTON

WHAT'S WRONG WITH THIS PICTURE?—XXII

Surge Tank, Continuous Blow-Off Heat Exchanger, and Vent-Condenser Piping—

See page 777

1. *No atmospheric vent on surge tank.* A vent is needed to relieve pressure and to allow air and other gas released from the incoming water to escape.

2. *No provision for draining surge tank.* A drain should be provided to facilitate cleaning and inspection.

3. *No manhole in surge tank.* Without a manhole, it is impossible to inspect or repair the interior of the tank.

4. *No gage glass on surge tank.* A gage glass is desirable to indicate level in tank.

5. *No overflow line from surge tank.* Overflow prevents level in tank from rising above a predetermined point.

6. *No float valve in makeup line.* Valve needed to control flow.

7. *No bypass for makeup water.* Bypass should be provided to supply makeup to deaerator or feed-pump suction, when tank is out of service.

8. *No bypass for condensate or returns.* Bypass to deaerator or waste should be installed to permit removing tank from service when necessary.

9. *Heat exchanger improperly located.* Temperature differential between water from surge tank and blowoff water is low, therefore a large exchanger is needed or temperature of blowoff water to waste will be high. If the heat exchanger were in the cold makeup line or the cold condensate line, results would be better.

10. *No bypass around heat exchanger.* Installation of bypass would permit removing exchanger from service without interfering with flow of feedwater.

11. *No control for continuous blowoff.* To regulate the quantity of blowoff, a calibrated or quantity-controlled valve should be provided, or manual control with some form of meter as reference may be used.

12. *Vent condenser water supply too hot.* Better results would be obtained if the cooling medium were either cold condensate or cold makeup.

13. *Air-vent line trapped.* Vent piping must be arranged so that the free flow of air and gas is not interfered with.

14. *No thermometers.* Thermometers should be installed in the inlet and outlet lines of the vent condenser and the heat exchanger. Cleanliness of heat transfer surfaces can be checked by watching temperature rise of cooling water.

Why Preheat Before Babbitting?

AGH'S QUESTION tempts me to ask: "Why preheat?" In the maintenance of a number of crude-oil pumps with 7x13-in. main bearings of the usual quarter-box babbitted design, more than 30 sets of bearings have been renewed without preheating. In each case, poured bearings have given longer and better service than did the originals.

Assuming that the babbitt is to be ⅜ in. thick, and that the iron shells carrying the babbitt average 1½ in. in thickness, each lateral inch of bearing will require 1.26 lb of bearing metal for the circumference of the shaft. To carry away heat from this molten metal there will be 14.25 lb of steel shaft and 3.97 lb of shell. The ratio of cold metal to hot babbitt is therefore 14.44:1, and there is more likelihood of too suddenly chilling the babbitt than there is of damaging the shaft by overheating.

The ratio of 14.44 lb of heat-conducting metal for each pound of hot babbitt does not take into account heat carried from the bearing by supports or by the shaft extending beyond the bearing. When this additional cooling material is taken into account, temperature increase by the relatively small amount of babbitt is negligible.

If there is room to make the switch, AGH can babbitt the quarter boxes as though each were a bottom section, to get around the slight difference in arc angularity produced by using cardboard blanks to segregate the different parts. Another scheme is to block the lower section into the correct position and to tamp each edge to refusal with fine fireclay or chalk (any dry material which will resist the wash of molten babbitt will answer). The two quarter boxes may then be poured in place, and the slight roughnesses at the bottom trimmed with a scraper to give a fit against the base section.

Longview, Texas M T PATE

Remove the Bearing for Babbitting

REMOVE the bearing from the pillow block, take out the old babbitt from each section and thoroughly clean the shell. If there are any doubts whether the new bearing metal will hold to the shell sections, drill shallow holes 0.25 in. deep on the inner surfaces of the shell sections. Treat the inside of the shell with a hydrochloric-acid solution, and assemble the bearing sections vertically on a piece of flat metal that is level.

Make a metal ring that will go around the outside of the shell assembly, drill and thread a hole in each quarter of the ring for tap bolts. Place the ring around the shell assembly and tighten the bolts onto each quarter to hold it firmly in place. Build up around the bottom end of the bearing with sand (dry moulder's sand is preferable).

Cut a piece of 6-in. pipe about 2 in. longer than the bearing and wrap it with a sheet of heavy paper. Heat the babbitt and the bearing. When the babbitt is at the correct temperature, center the piece of pipe in the shell assembly and pour the babbitt around it. Let the bearing cool, take out the pipe, and on a lathe turn out the excess babbitt. Make the bore in the bearing about 0.02 in. larger than the journal (about 0.0025 in. larger per in. of journal diameter).

After machining the bearing, cut the quarters apart with a hacksaw, and finish the edges. Do not try to pour the bearing in place, because you cannot do as good a job.

Detroit, Mich. LEONARD LONG

COMPRESSED AIR FOR SOOT BLOWING

Answers to October Question 2

The Question

A MANUFACTURING *plant used compressed air for blowing soot from several hrt boilers for a number of years and then switched to steam. We have heard that compressed air has an injurious effect on the tubes. Can any*

(Continued on page 120)

Guaranteed Performance

Created--

To meet the demands of a rapidly expanding process for rebuilding and reconditioning mechanical equipment efficiently, comes this instrument of fine precision by Stevens.

- *Speedy*
- *Rugged*
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EXCLUSIVE FEATURES:

High capacity nozzle » » Automatic Wire Feed Device » » Gear Shift Assembly 800-1. . . to 1600-1. "No Gear Change Required." Mechanical Assembly readily removable for Inspection. Ball Bearing Mounted and Self-Lubricated.

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Write

STEVENS METAL SPRAYING, INC.

81-83 SHIPLEY STREET, SAN FRANCISCO, CALIF.

HIGH HAT....

J T HARAHAN, president some years ago of the Illinois Central, was sitting in his office when a burly yardman entered without knocking. "Me name's Casey," he bellowed, "Oi wur-ruk in the yarrds. Oi want a pass to St. Louis!"

Harahan objected, "That's no way to ask for a pass. Introduce yourself politely first. Come in in an hour and try again."

At the end of the hour there was a timid knock on the door. It was Casey. Doffing his hat, he inquired, "Are yez Mr Harahan?"

"I am."

"Me name's Patrick Casey. Oi've been wur-ruking in the yarrds."

"Glad to know you, Mr. Casey. What can I do for you?"

"Yez can go to Hell. Oi've got a job on the Missouri Pacific!"

Every once in a while, I see a chief that reminds me of that old yarn. He is BOSS, and he wants every man who works for him to know it. He bellows his instructions, he orders his men around, he expects bowing and scraping every time he passes. He wants no explanations, no suggestions, no remarks, not even a pleasant greeting.

Such an attitude may feed his ego, but it starves his mind. We mortals are so constituted that we go off half-cocked every so often unless a little normal contact with other human beings—both above and below us—keeps us straight. The oiler who sees a poor drive, the water tender who offers a change in valves, the fireman who plans a different method of ash-handling—none of these is an upstart or job-snatcher. Each is trying to do his own job better, and in so-doing to make the whole crew a better working unit. The man full of suggestions is in nine cases out of ten the man most worth keeping. The man who never makes a suggestion, who always awaits instructions before lifting a finger, is also the man who is useless in emergency—because he's forgotton how to think for himself.

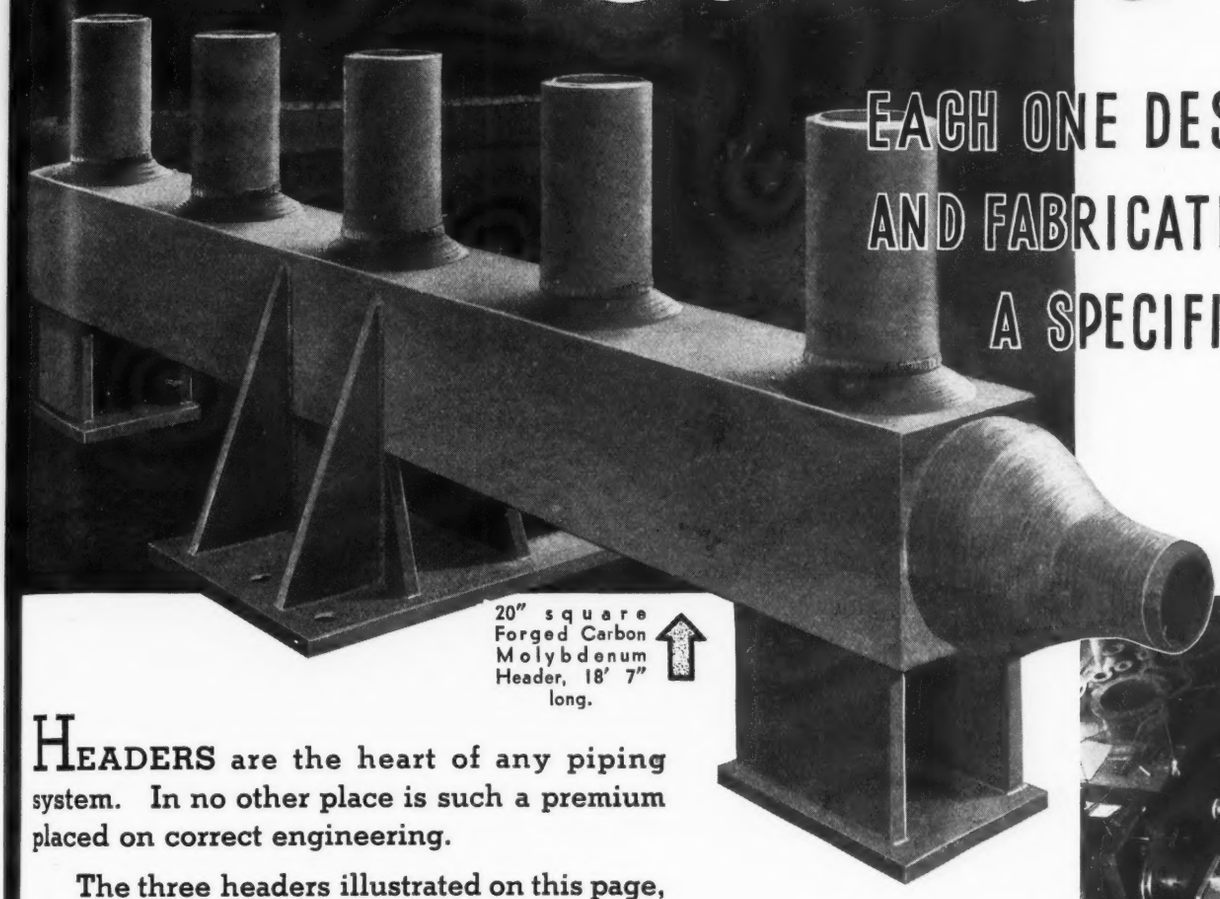
So, if you're wearing a high hat, doff it at least once in a while. Have your men working *with* you, not *for* you, and both they and your plant will operate at higher efficiency. Otherwise, you may find your best potential talent leaving unceremoniously to work for the Missouri Pacific.

George Edwards

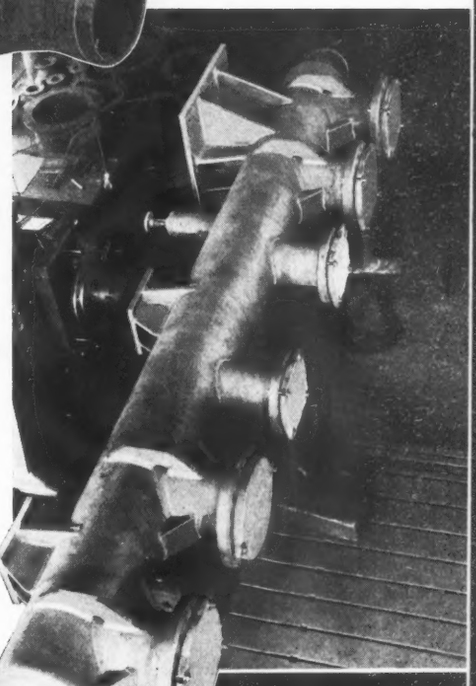
GEORGE EDWARDS
Engineer

Headers

EACH ONE DESIGNED AND FABRICATED FOR A SPECIFIC JOB

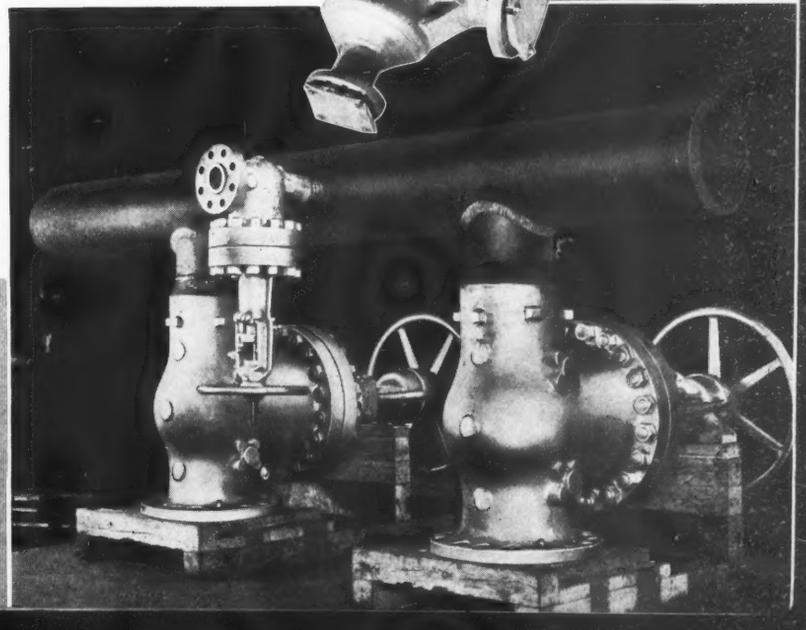


20" square Forged Carbon Molybdenum Header, 18' 7" long.



24" Carbon Steel Header, 23' long.

All-welded Carbon Steel Header with Valves Attached.



HEADERS are the heart of any piping system. In no other place is such a premium placed on correct engineering.

The three headers illustrated on this page, fabricated and erected this year by Pittsburgh Piping, serve to illustrate the wide variations in design, materials and construction methods required for this important part of modern power plants.

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A Goetze Gasket helped build New York's New Lincoln Vehicular Tunnel. Deep down in the ground, where the open shaft joined the steel tunnel rings—this 34' diameter gasket, weighing 1,500 pounds, held out the Hudson River throughout the construction period.

A spectacular gasket! Unusual in its size! But no more remarkable in what it did than are the gaskets we make for you . . . the thousand and one standard and special gaskets we supply to American industry.

When you drive through this new tunnel, think of Goetze. When you need gaskets, think of Goetze. Send for complete catalog of standard gaskets. Goetze Gasket & Packing Co., Inc., 10 Allen Ave., New Brunswick, New Jersey.

Goetze
for GASKETS

Readers' Problems

(*Continued from page* 116)

POWER *readers give me some first-hand information on compressed air for soot blowing?*—EHR

Air Avoids Damp Soot

IT IS my opinion that the manufacturing plant referred to switched from compressed air to steam for blowing soot from boilers because the demand for compressed air was approaching the limits of available supply, whereas an abundant supply of steam was available for the purpose.

The advantages of compressed air for sootblowing appear decided compared with steam, with the possible exception of cost. Compressed air is comparatively dry, which favors its use, as dampened soot blows free with great difficulty. Improperly drained steam sootblowers cause a blast of condensate to spray over the soot before blowing starts. Slight leakage from a compressed-air sootblower usually causes no damage or trouble outside of the economical standpoint. Leakage of a steam sootblower may cause serious external corrosioin of some part of the boiler.

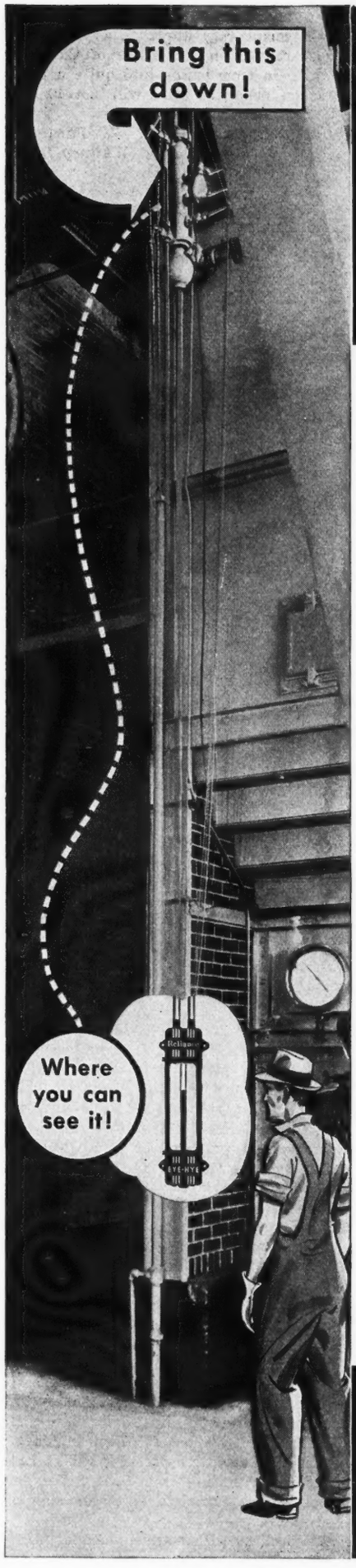
The possibilities of damage by compressed-air sootblowers are no greater than with steam. The damage is caused by an improperly adjusted blower—(either air or steam) when the jet impinges directly against some part of the boiler in close proximity. The ash and soot particles act as a sandblast and have been known to wear a hole through a boiler tube in a short time.

Flushing, N. Y. HARRY M SPRING

Chief Objection to Air is Cost

THE chief objection to compressed air is its cost, but the results to be obtained, I think, are much better with air than with steam, as there can be no injury to boiler tubes with the former. I have heard arguments that the blast of compressed air going through a boiler tube would chill the tube, setting up contraction stresses which would result in leaks. This has not been borne out by my own experience, and if we give any thought to the problem, it appears ridiculous to believe that a blast of air going through a boiler tube could bring about any cooling of that tube when the tube is entirely surrounded by water at a higher temperature.

There is, however, with steam the constant possibility of moisture being deposited in the tube, which also seems unbelievable because hot gas going through the tube ought to be sufficient to evaporate any such moisture and thereby prevent any condensation remaining in the tube. However, I have seen ample evidence of the fact that moisture has been blown into the tube



Reliance EYE-HYE

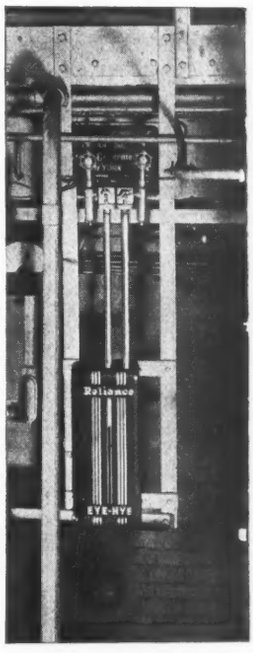
Remote-Reading Water Gage

Gives You Safe, Convenient, Instant Water Level Control

EYE-HYE, the remarkable new Reliance Remote-Reading Water Level Gage, brings that high-on-the-boiler, hard-to-see water gage right down to the boiler-room floor in front of your nose.

Because of its scientific accuracy, it shows you the true water level in the boiler. At a glance, you see the bright green indicator liquid, illuminated and clear — you **know** exactly where the water level is. Saves climbing to see, avoids uncertainty.

The modern design case of the EYE-HYE adds to your pride in an efficient instrument board. It's easy to install — tubing comes down around corners, girders, piping. Positive U-tube principle with non-mixing Vizzene liquid. Proved dependable—same engineering and manufacture that set the record of nearly 150,000 Reliance boiler alarms on duty and not one known to fail in an emergency.



Reliance High Pressure EYE-HYE in the boiler room of the Celluloid Corporation, Newark, N. J.

Investigate this sound investment in safe, efficient, economical boiler operation. Write today for the facts.

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SAFETY WATER COLUMNS

INSULATION FAILURE TIES UP PLANT 24 HOURS

Don't Let This Happen To You!

Due to weakened insulation, an important feeder cable "let go" recently in a large mill in New Jersey. Result—complete shut-down of the plant for 24 hours, and the Electrical Engineer *"on the spot."*

It happened, however, that for six months the Electrical Engineer had been trying to convince the management that a "Megger" insulation testing instrument would detect weaknesses in their incipient stages and forestall just this kind of trouble—would save money for the plant and incidentally *protect him.* But because they had been "getting along" without it, his recommendation for a "Megger" was refused and the "inevitable" happened—a 24-hour shut-down of the *entire* plant at a time when they were running three shifts.

Needless to say . . . He got his "Megger"!

A recent model of our "Meg" Insulation Tester with a 500-volt hand generator and ohmmeter for measuring conductor resistance in ohms and insulation resistance up to 100 megohms.

Trouble like this is being forestalled every day in plants where maintenance departments make periodic insulation resistance tests with "Megger" instruments.

Write today for descriptive Bulletin 1355-P which will help you to select the type and rating of "Megger" instrument best suited for the electrical equipment in your plant.

JAMES G. BIDDLE CO.
1211-13 Arch Street, Philadelphia, Pa.

"MEGGER" INSTRUMENTS

and mixed with the soot. While only of a momentary duration, a packing of soot results on the inside of the tube, which in time builds into quite a thick carbon deposit. This will not happen with compressed air.

Hartford, Conn. HARRY W BENTON
Pratt & Whitney Div

Cost Makes Steam Superior

MY CHIEF reason for using steam rather than air is cost. The cost of air in industrial plants will vary from 3 to 10 times the cost of steam, depending on the type of compressor. If EHR knows the cost of his steam and air, he can closely approximate the quantities used by summing up the areas of his sootblower-nozzle openings and applying the following formulas: For steam, $W = \frac{AP}{70}$; for air, $W = .53A\frac{P}{\sqrt{T}}$

where W = Pounds per second, A = Area in sq in., P = Abs pressure in lb per sq in., and T = Absolute temperature.

A steam sootblower has a disadvantage that is more serious in a water-tube boiler than in an hrt. If drains do not function properly, condensed steam will eventually drain through the nozzles causing severe corrosion wherever water drips. In watertube boilers, the drip is usually on the boiler tubes.

Compressed air might be injurious where there are accumulations of glowing slag or conditions are such that the air can support combustion. Such conditions are extremely remote in normal operation of hrt boilers.

Bound Brook, N J WM ROHRHURST
Calco Chemical Co, Inc

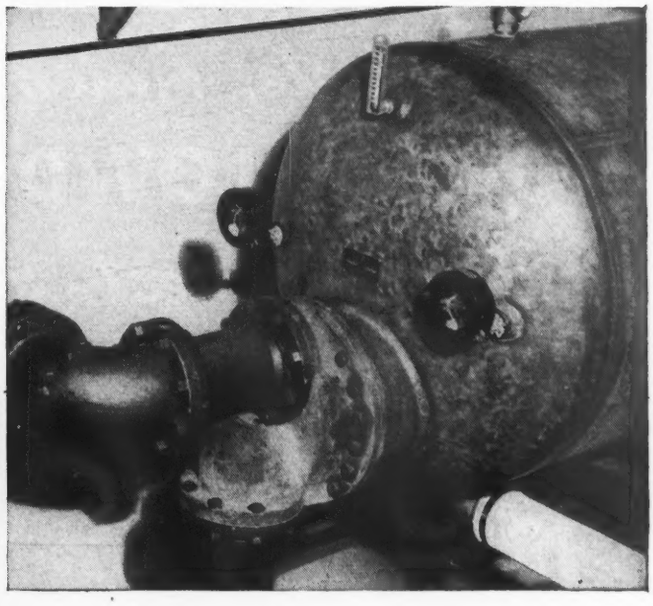
Compressed Air Also Better For Oil

FOR the past 15 years I have been advocating and installing compressed-air equipment for sootblowing to replace steam equipment. The points against the use of steam are: When coal is fired, moisture from the steam combines with ash in the soot to form hard aggregates, which often must be cut away with chisel and hammer before passages are again clear. Also, wet steam and soot when intimately mixed, as in sootblowing, tend to form a pasty sludge which adheres to the lower sides of tubes and similar surfaces, hardening there and hindering heat transfer.

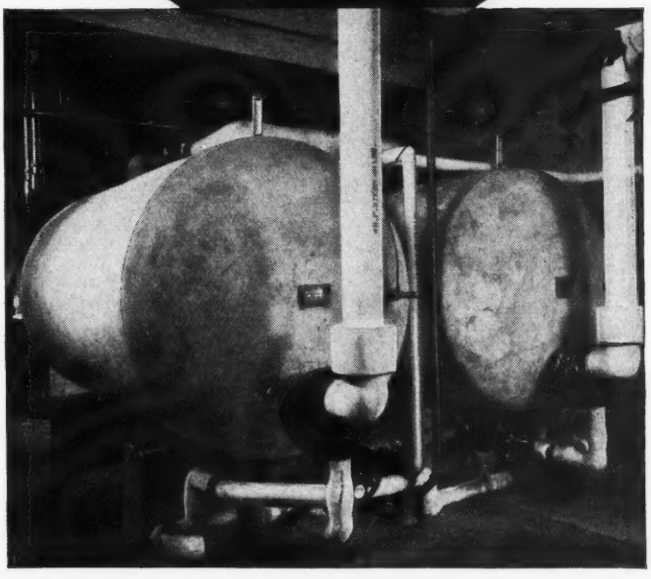
When oil is fired, steam combines to a greater or less degree with the sulphur products resulting from combustion, forming a corrosive acid which is apt to be sufficiently concentrated in spots to attack the metal and greatly weaken it, even in a short time. The greasy soot from oil also forms a paste with droplets of water from condensed steam. This paste does not get as hard as that resulting from coal firing, but possesses a considerably larger clinging strength.

When, as with many industrial plants

Rustless... strong... easily welded... no wonder the choice is EVERDUR Silicon Bronze



Club . . . For an exclusive club in upper Manhattan, this Patterson-Kelley solid EVERDUR "Lo-Flo" hot water service and storage heater assures a constant supply of rust-free hot water. Size 42" x 168". Storage capacity 1,000 gallons. Heating capacity 1,750 gallons per hour. This heater was brought into the building in eight pieces, and electrically butt welded on the job by the Patterson-Kelley Co.



Institution . . . At the New York City Penitentiary laundry on Riker's Island, these two Patterson-Kelley solid EVERDUR storage heaters provide rust-free hot water and permanent freedom from repair expense due to rust. Each is 60" x 120" and of 1,400 gallons capacity. Heating capacity 2,000 gallons per hour. Sloan & Robertson, New York City, Architects. Clark, MacMullen & Riley, Consulting Engineers. C. H. Cronin, Inc., Plumbing Contractor.

MORE and more property owners are discovering the economy of non-rust EVERDUR Metal for hot water storage heaters. Thus, instead of rust-discolored water from tanks of limited life, they obtain an enduring supply of rust-free hot water. They can forget about the possibility of repairs or replacements due to rust!

EVERDUR is "in a class by itself" for durable heaters because it is rustless as copper, strong as steel, and easily welded. Furnished in all commercial shapes, including tank plates which conform to all requirements of A.S.T.M. Specification B96-36T. Obtainable from leading equipment manufacturers.

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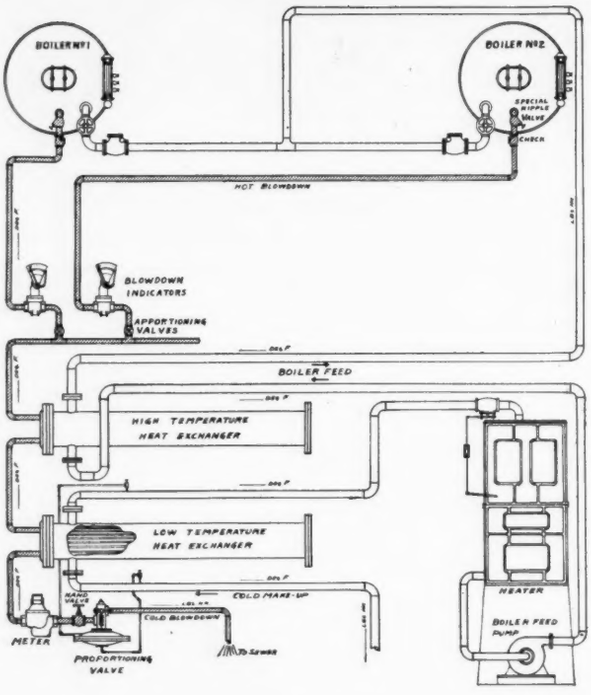
EVERDUR is a trade-mark of The American Brass Company, registered in the United States Patent Office.

Complete, Automatic

BOILER BLOWDOWN

without heat-loss!



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CONTINUOUS BLOWDOWN

This system automatically holds the concentration of your boiler water at a predetermined proper degree. This is accomplished by blowing down in proportion to the total quantity of makeup water—*without heat loss.*

Fill in and mail the coupon for further detailed information about this remarkable system.

HENSZEY CO. *Dept. D 12* **Watertown, Wis.**

I would like to know more about Continuous Blowdown.

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in the South, wood or wood wastes are fired, steam for blowing soot—or in this case largely fine ash—gives a source of water to combine with chemicals formed or resulting from wood combustion, principally alkalies, which are corrosive and may attack metals.

Compressed air, properly dried, contributes to none of the conditions listed above, and is not harmful to metals, unless they are heated enough to have the ordinary process of slow oxidation accelerated by the blast of air. In my experience, I have found that a blast of cold compressed air played against a 3-in. boiler tube heated to redness will almost instantly cool the metal to black at the area of impingement, even though the tube be maintained at red heat on both sides of the air blast. Accelerated oxidation, therefore, is of extremely short duration in any normal condition of sootblowing.

Air should not be used if the mixture of air and soot is in any danger of coming in contact with a flame, spark or incandescent gas, as the mixture of soot and air is highly explosive.

With ordinary precautions against fire, advantages of air over steam for sootblowing are obvious; one gain being that air may be stored against the time of its need, while steam for sootblowing is available only if some unit of the plant is fired and producing steam.

Kilgore, Texas C C LYNDE

Engineers' Books

Oil Burning

OIL BURNING (1937)—*By H A Romp. Published by Martinus Nijhoff, The Hague, Netherlands. 336 pages, 7¼ x 9½ in., 262 illustrations, 7 tables. Price 12 guilders (about $6.60).*

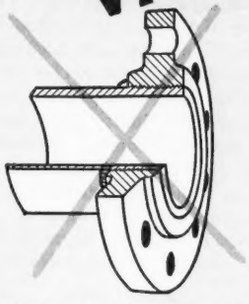
For those who wish to study oil burning in detail, this book presents in English much information not found in American literature. After dealing thoroughly with the history of oil burning developments, the author covers in a complete manner the theory of the combustion of fuel oil and draws some interesting comparisons with flames in oil engines. Chapters on automatic oil burners and controls of both domestic and industrial types are well illustrated and a variety of equipment is described in detail. It is a book well worth study by those interested in the technical aspects of oil burning and oil burners.

Refrigeration

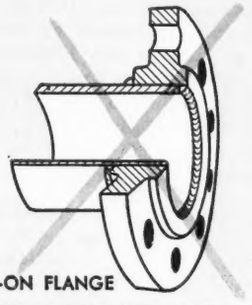
REFRIGERATION ENGINEERNIG (*1937*)—*By H J Macintire, professor of refrigeration, University of Illinois. Published by John Wiley & Sons, Inc, 440 Fourth Ave., New York, N. Y. 415 pages, 6 x 9 in. 136 drawings, 78 tables. Price $4.50.*

Rearranged from the author's former "Handbook of Mechanical Refrigera-

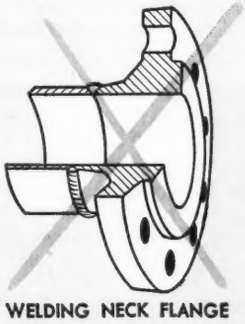
MIDWEST VAN STONE WELDING NIPPLE makes the *ideal* flanged joint for welded piping systems



SCREWED AND WELDED FLANGE



SLIP-ON FLANGE
WELDED FRONT AND BACK



WELDING NECK FLANGE

For making connections to boilers, pumps, valves and other flanged outlets (and where piping must be frequently cleaned or inspected for corrosion), Midwest Van Stone Welding Nipples have a tremendous advantage over flanges that are welded to the pipe (see drawings at left). The swivel flange of the Nipple makes it unnecessary to accurately line up the bolt holes before welding; "setting up" is simple and quick because no special clamps or jigs are required to hold the face of the flange absolutely perpendicular to the axis of the pipe. The result is a real saving in time and cost of welding.

Another important economy is in erection. Field organizations report a saving of 25% in erection time for making up a joint using Midwest Van Stone Welding Nipple in comparison with flanges rigidly fixed to the pipe; this saving is even greater when the flanges are on bends.

Ask for Bulletin WF-36 which gives complete data regarding Midwest Van Stone Welding Nipples . . . and other Midwest Welding Fittings that simplify and save on welded piping.

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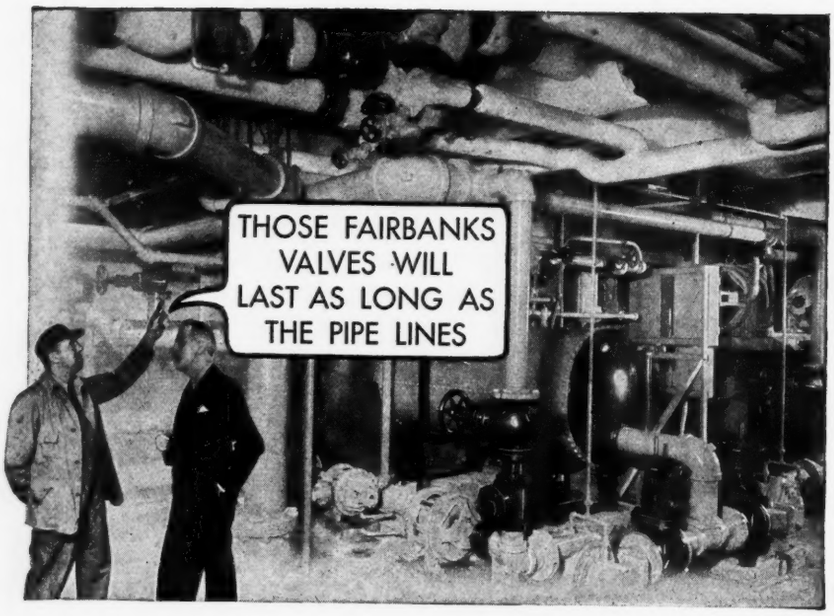
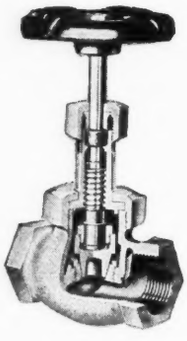
Plants: St. Louis, Passaic (N. J.) and Los Angeles • Sales Offices: Chicago—946 Marquette Bldg. • Houston—1716 Second National Bank Bldg. • Los Angeles—520 Anderson St. • New York—(Eastern Division) 30 Church St. Tulsa—533 Mayo Bldg.



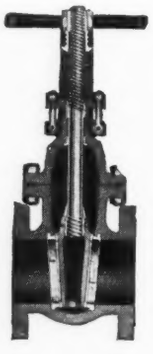
You'd probably be astounded if you knew what a large sum it costs you every year for valves that employees scrap simply because the inexpensive seats or wedges are worn.

You can stop that deplorable waste by replacing antiquated valves with Fairbanks RENEWABLE Valves, for they last as long as the pipe line.

The seat rings or wedges may eventually wear, but they can be replaced in a few minutes by one man without removing the valve from the line. And instead of paying, say, $5.00 for a new valve, you simply pay about 65c for new seats. Multiply that $4.35 saving with the number of new valves you buy every year!



You will find many other money-saving achievements in Fairbanks Renewable Valves. Learn the facts about these valves before you buy. Compare them for yourself, feature for feature. Then buy on value alone.



We are so certain that Fairbanks Renewable Valves will save you money that we are willing to send one for a 30 day trial. If you are not perfectly satisfied, return it and we will make no charge.

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Fairbanks Renewable Valves

tion," this text begins with the theory underlying refrigeration, then lists units, elements, various cooling jobs, etc. One chapter covers condensers, evaporators and coolers, another piping and fittings, another erection, operation and testing. One chapter discusses air conditioning, comfort cooling and sound control, another cold storage, still another ice manufacture. Included in machine types are adsorption and absorption units, compression, automatic and household units.

Because of the combination of theoretical data, operating information, and data on all systems and types, the book will prove of value both to students and to the practicing engineer needing a reference manual. Treatment is clear and concise, the book is logically arranged, and plenty of illustrations make the author's meaning constantly clear. All necessary reference tables are included, as well as Mollier diagrams for Freon and ammonia. The diagrams, a psychrometric chart and a Reynolds number chart are folded in for convenient use.

BRIEF REVIEWS

MECHANICAL CATALOG, 1937-38. *27th annual volume published by American Society of Mechanical Engineers, 29 West 39th St., New York, N. Y. 8½ x 11½ in. Issued free to members on request.*—Describes over 1600 products, and lists more than 850 firms under 4800 classifications of equipment.

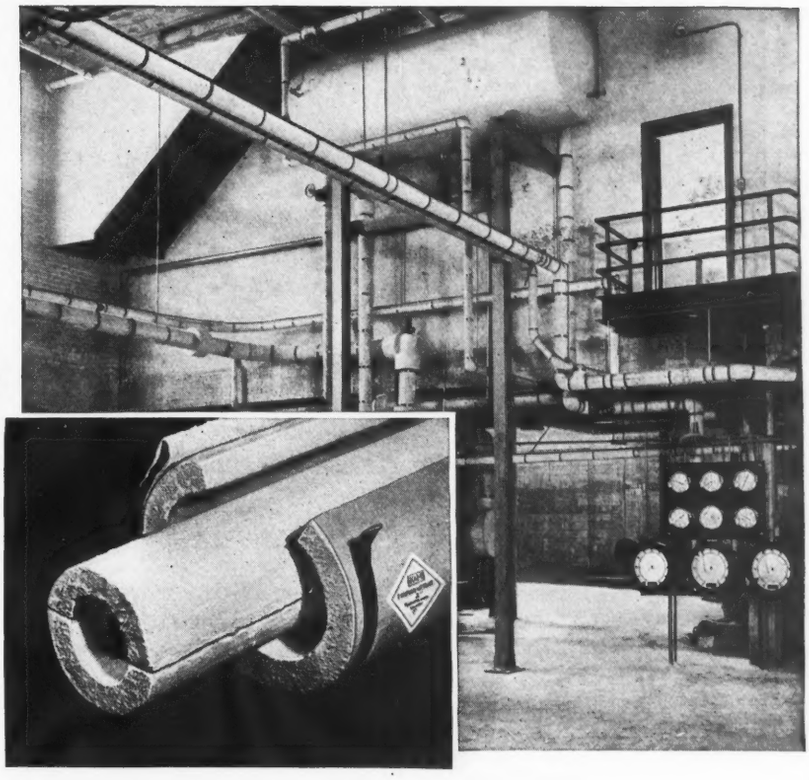
DIESEL PROGRESS OF SMALL MARINE AND AUXILIARY ENGINES. *By T B Danckwortt. Issued by Danckwortt Diesel Engineering Co, Balboa, Cal. Distributed on request*—A reprint from U S Naval Institute Proceedings, Sept 1937, describes advantages of small diesels for marine and auxiliary applications.

BIBLIOGRAPHY OF U. S. BUREAU OF MINES INVESTIGATIONS ON COAL AND ITS PRODUCTS, 1910-35. *By A C Feildner, Allen H Emery, and M W von Bernewitz. 145 pages, 5 cents.*—Lists nearly 2000 reports on subject by members of Bureau of Mines personnel. Includes index by subjects and authors.

BURNING OF COAL AND COKE TREATED WITH SMALL QUANTITIES OF CHEMICALS. *By P Nicholls, W E Rice, B A Landry, and W T Reid. Bulletin 404 of U S Bureau of Mines. 158 pages, for sale by Supt of Documents, Washington, D. C., 15 cents.*—A complete discussion of various tests with chemicals, giving results, on coal and coke.

TECHNOLOGICAL TRENDS AND NATIONAL POLICY. *400 pages, paper cover. For sale by Supt of Documents, Washington, D. C. Price $1*—A report of the National Resources Committee, Dept of the Interior, on technological trends and their social implications, which attempts to show the kinds of new inventions which may affect living and working conditions in America during the next 10 to 25 years.

Heat insulation that pays permanent dividends



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"FEATHERWEIGHT" 85% MAGNESIA

You start to save money the moment you install 85% Magnesia insulation. And it is a saving that never ends. For not only is 85% Magnesia one of the most efficient heat insulators ever developed . . . its durability is almost unique.

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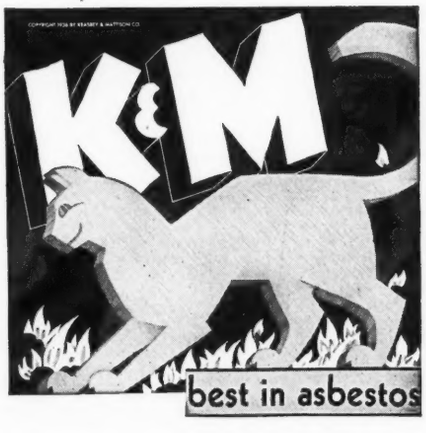

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Adjustment of anti-friction bearings on this Kinney Pump is taken care of by Laminum shims. They fit on both shafts, in the ball thrust bearings, and fix the location of the "Heliquad" rotors endwise in the pump casing. Precision adjustment . . . merely by peeling off the .002 in. (or .003 in.) laminations! Write for Laminum sample.

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MID-DECEMBER ISSUE

1. **Piping, Valves, Fittings — Applications.** Brief, comprehensive illustrated treatment on typical pipe joints, piping systems for high-pressure, low-pressure steam, water, oil, refrigeration, compressed air, heating. Also a page on instruments.

2. **Significant Power Developments of 1937.** Editors' check-up on the course power engineering is taking and the distance traveled during the past year. Will help you build a continuous picture of power progress.

3. **Review Annual A.S.M.E. Meeting.** Resumes of all papers of interest to power operating men.

4. **New Products of 1937.** Brief descriptions of 300 products described in POWER during the year. Items classified by type. Excellent product review you'll want to read and save.

STRAWS (Continued)

gas engine units to be operated with waste sewerage gas from digestion tanks at disposal works. Cost about $84,400.

Glidden Co, 5165 W Moffatt St, Chicago, contracted James Shedden & Co, 20 N Wacker Drive, for 3-story boiler house at local paint and varnish plant, 26x48 ft. Cost over $50,000, with boiler units and auxiliary equipment.

Fulton Market Cold Storage Co, 100 W Fulton St, Chicago, Ill, has contracted Morton R Mavor, 7 South Dearborn St, for 2-story cold storage and refrigerating plant at 327-29 North Carpenter St, 58x125 ft. Cost over $65,000.

INDIANA — Board of School Trustees, Richmond, C K Robinson, secretary, plans 1-story boiler house, 60x60 ft, at new multi-story senior high school. Cost about $573,000.

Fort Wayne State School, Fort Wayne, plans steam power plant at its Muscatatuck Colony institution, Butlerville $250,000 arranged for plant and two other buildings.

Fort Wayne Roman Catholic Diocese, Fort Wayne, Edward J Disser, chairman of building committee, Old First Bank Building, Fort Wayne, plans central-heating plant in multi-story high school at Lewis and Clinton Sts.

IOWA — Clayton Royer, Adel, has leased local Hutchins Bldg, and will remodel and equip for new cold storage and refrigerating plant.

Louisa-Des Moines Drainage District No. 4, Burlington, contracted Worthington Pump & Machinery Corp, Harrison, N. J., for diesel and auxiliary equipment for pumping station.

Waverly contracted Worthington Pump & Machinery Corp, Harrison, N. J., for diesel-generating units, switchgear and auxiliary equipment for extensions in municipal power station, at price of $170,718.

Dyersville Cold Storage Locker Co, Dyersville, plans 1-story cold storage and refrigerating plant, 25x120 ft. Cost close to $50,000.

Board of Education, Iowa City, Iowa, plans central-heating plant in multi-story high school. Cost $700,000. Financing through Federal aid. Work scheduled to start January, 1938.

KANSAS — Diamond Ice Co, Cottonwood Falls, contracted General Refrigeration Sales Co, 1931 Main St, Kansas City, Mo, for extensions in cold-storage and refrigerating plant. Cost over $45,000.

LOUISIANA — Sewerage and Water Board, New Orleans, plans electric-operated pumping station on London Ave, for municipal water system.

Livingston Parish Police Jury, Springville, plans central-heating plant in new courthouse at Livingston. Cost $175,000. Financing through Federal Aid.

State Normal College, Natchitoches, plans central-heating plant in new high and trades school Cost $550,000. Financing through Federal aid.

Arkansas Fuel Oil Co., Slattery Bldg, Shreveport, plans power house, compressor plant and pumping station at new natural gasoline plant in Rodessa, Tex., oil field area, vicinity of Jefferson, to be equipped to process about 25,000,00 cu ft of natural gas per day. Cost over $100,000.

MAINE — Central Maine Power Co, plans dam and hydro plant at Caratunk Falls, near Solon. Preliminary engineering work has already been started. Various industrial plants along the Kenebec River will be assured under this project of a "leveling off" in the flow of the river, which at present is largely controlled by Central Maine's station at Bingham.

MARYLAND — Hagerstown contemplates extensions in municipal power plant, including installation of new steam turbine-generator unit for auxiliary service and other equipment. Cost about $200,000. R R Daniels, superintendent.

MASSACHUSETTS — Department of

WHEN FUSES TAKE A "HOLIDAY"

Everybody Loses!

PRODUCTION STOPS—machines stand idle—man-power can't produce—orders are delayed—costs rise, and PROFITS are lost.

Unfortunately, not all fuse "holidays" are caused by overloads. Three out of four are directly traceable to *inefficient* fuses—*tampering* with fuse links, and *bad clip contact*.

Today, in the largest and best equipped plants, TRICO *Powder-Packed* Renewable Fuses and KLIP-LOK Clamps are a definite protection standard only because some time or other their Engineers and Plant Superintendents have learned that these *UNNECESSARY* and *UNJUSTIFIABLE LOSSES* could be eliminated with this famous TRICO COMBINATION.

There's no secret about TRICO's superior performance. Your electrical knowledge will verify that such engineering refinements as listed below must eliminate

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WASTEFUL SHUTDOWNS

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That powder-packed element is worth a million dollars—yet COSTS NO MORE!

TRICO *Powder-Packed* FUSES

- Self-contained **Powder-Packed** renewal element. (It's different) No chance for mistakes—always safe—always dependable—fuse link carefully protected against damage.
- **Tamper-proof** protection. Stops dangerous practice of "doubling up" fuse links.
- **Non-Interchangeable** construction—prevents the inefficient practice of substituting *ordinary* bare links.
- **Link Support**—The powder-packing prevents sagging and stretching of fuse link—stops **premature** blowings.
- **Safe Time Lag**—TRICO has had it for 18 years—not overdone to prevent early deterioration of motors and wiring.
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The great waste of money and material, and disgusting clip conditions, can now be eliminated, especially when **KLIPLOK** clamps are installed on new equipment.

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KLIPLOK clamps are correctly designed and built to last indefinitely. They will effect a great saving when installed on both new and old equipment.

When you buy **KLIPLOK** Clamps you buy fuse and clip insurance. And the cost thereof is wiped out by eventual saving.

Fully covered by U. S. Patents.

TRY TRICO TODAY!

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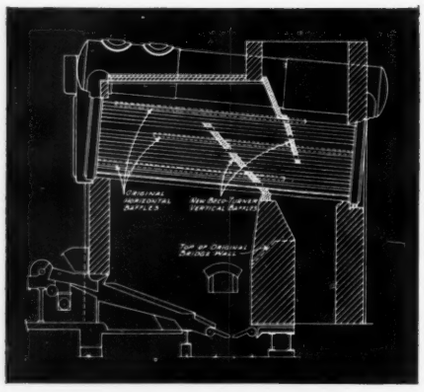
BAFFLES
raise capacity



from 150 to 250%

THE performance of horizontally-baffled boilers can be improved to a considerable degree by replacing existing baffles with vertical Beco-Turner baffles. The print above represents two 518 hp. boilers at the Virginia Water & Light Plant, Virginia, Minn., where Beco-Turner baffles raised the maximum capacity of the boilers from 150 to 250 per cent of rating.

With horizontal baffles, approximately 25 per cent of the tube surface is wasted. It does not come in contact with the hot gases. On the other hand, Beco-Turner vertical baffles bring practically the entire heating surface of the tubes into contact with the gases. They put the entire boiler to work. The capacity and efficiency of the boiler are increased while flue gas temperatures and fuel consumption are decreased.

Beco-Turner baffles are constructed of self-hardening refractory material that fits snugly around the tubes. They are featured by their patented expansion joints which keep them gas tight.

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Send blueprints and our engineering department will submit any possible recommendations for improving your baffle design.

Mental Diseases, Boston, plans improvements in power plant at State Hospital at Grafton, including oil-burning equipment. Cost close to $30,000. R D Kimball Co, 6 Beacon St, Boston, consulting engineer.

Board of Trustees, Massachusetts Institute of Technology, Cambridge, contracted McCreery & Theriault, 303 Columbus Ave., Boston, for 1-story motor-generator station, 21x48 ft Cost reported close to $60,000, with equipment. Plans are under way for new wind tunnel and experimental laboratory at institution, to cost about $125,000. Jackson & Moreland, 31 St. James Ave., Boston, consulting engineers for both projects.

H P Hood & Sons, Inc., 500 Rutherford Ave., Charlestown, contracted A H Drisko 89 Broad St, Boston, for boiler house at milk products plant. Cost close to $40,000.

School Board, Shrewsbury, plans central-heating plant in 5-story junior and senior high school. Cost about $390,000.

MICHIGAN —— Fruehauf Trailer Co, 10940 Harper Ave., Detroit, plans 1-story boiler house at plant, in connection with other buildings for expansion. Entire project will cost over $100,000.

Bay Pipe Line Co, and Bay Refining Corp, 205 Bearinger Bldg., Saginaw, plans welded-steel pipeline from oil field area in Buckeye Township, Gladwin County, to Bay City, about 33 miles, for crude-oil transmission. Booster stations will be installed. Cost over $250,000.

Dept of Public Works, City Hall, Detroit, has low bid from Bass Engrg & Const Co, Curtis Bldg, for gas-engine-generator unit for Detroit sewage disposal plant at $27,295, and will place award soon.

Thumb Electric Co-Operative, Inc, Bad Axe, contracted Fairbanks, Morse & Co, Chicago, for diesel-generator units and auxiliary equipment at $187,500.

MINNESOTA —— Boote's Hatcheries & Packing Co, Inc, Worthington, J C Boote, president, plans 1-story cold-storage and refrigerating plant at meat-packing plant. Cost close to $45,000, with equipment.

MISSISSIPPI —— Adams-Edgar Lumber Co, Morton, plans boiler plant at 3-story lumber and woodworking mill on local site, 210x260 ft. Cost close to $90,000. Stephen Shea, Lake Charles, La., engineer.

Ittabena contemplates municipal electric plant and distributing system. Cost about $50,000. Bond issue being arranged.

MISSOURI——United States Engineer Office, St. Louis, contracted S C Sachs Co, for power, control and lighting system at Lock and Dam No. 26, Mississippi River near Alton, Ill., at $192,897, including gasoline-electric standby power unit, power substations and other structures.

Board of Directors, Northeast Missouri State Teachers' College, Kirksville, plans central-heating plant in new junior high school and administration building. $300,000 being arranged.

Board of Regents, Maryville Teachers' College, Maryville, plans central-heating plant in new Horace Mann training school. $250,000 has been authorized.

State Building Commission, state House, Jefferson City, plans central-heating plant in multi-story state office building on West High St., for which $850,000 has been authorized Keene & Simpson, Land Bank Bldg, Kansas City, architects.

NEBRASKA —— Battle Creek has authorized bonds for $68,000 for municipal electric plant.

Nebraska State Board of Control, State House, Lincoln, L D Hart, secretary, plans central-heating plant in new state hospital building at Ingleside. $363,600 has been arranged.

NEW JERSEY—Home Fuel Oil Co, Inc, 223 River Drive, Passaic, N. J., plans steel tanks and pumping equipment to cost about $100,000 at proposed new bulk oil storage and distributing plant at Port Newark.

NEW MEXICO—Central Valley Electric Corp, Artesia, I S Reser, president, will take bids soon for equipment for power plant for rural electrification system, including two 450-kw and one 300-kw generating units. Cost about $125,000. Distributing system will cost $135,000. Financing through Federal aid. E. T. Archer & Co, New England Bldg, Kansas City, Mo., consulting engineers.

NORTH CAROLINA —— High Point contemplates municipal hydroelectric plant on Yadkin River. E M Knox is city manager, in charge.

Rocky Mount, will award contracts soon for improvements in municipal power plant. William C Olsen, 5 Exchange Place, Raleigh, consulting engineer.

NORTH DAKOTA —— Valley City contracted A R Robertson Co, 1603 University Ave, St. Paul, Minn., for steam turbine-generator, surface condenser and auxiliaries for municipal power plant expansion. Burlingame, Hitchcock, Estabrook, Sexton Bldg, Minneapolis, Minn., consulting engineers.

OHIO —— Timken Foundation, Canton, plans central-heating plant in new 3-story Timken Technical High School. Cost about $1,000,000.

Monroeville plans water-softening and purification plant for municipal water system. Cost about $52,000, with pumping machinery and other equipment.

Mansfield plans motor-driven pumping units and auxiliary equipment in Maxwell station for waterworks system; also steel water tower.

Cimatool Co, Dayton, plans 1-story boiler house, with gas-fired boiler units, at new tool works, 200 x 380 ft. Cost over $150,000.

Cuyahoga School District Board of Education, East 71st St, Cleveland, plans central-heating plant in 2-story high and grade school. Cost about $500,000.

State Department of Education, Columbus, has authorized installation of new ice-manufacturing and cold storage plant at State Boys' Industrial School, Lancaster. Cost about $36,000. J P Schooley, State Office Bldg, Columbus, state architect.

State Dept of Education, Columbus, plans improvements in power house at Wilberforce University, Xenia, including 125-kw & 75-kw engine-generator units.

OREGON——State Dept of Institutions, Salem, plans 1-story boiler house at State Hospital, The Dalles. Also new mechanical laundry and other buildings. Cost $174,000.

Rogue River Canning Co, Medford, plans improvements in cold-storage and refrigerating plant at local cannery.

PENNSYLVANIA——Hope Natural Gas Co. 545 William Penn Way, Pittsburgh, will build 10-in. welded-steel pipeline from Peora, W. Va., to Bridgeport, near Clarksburg, W. Va., about 7 miles, for natural gas transmission, replacing present 6-in. pipe line. Cost close to $50,000.

Ridgway contracted Dravo Corp, Neville Island, Pittsburgh, for pumping machinery and auxiliary equipment for municipal water station, with rated capacity of 900 gpm.

TEXAS——Board of Directors, Texas College of Arts and Industries, Kingsville, plans central-heating plant in new multi-story science building. Cost about $210,000.

Andrews contracted Kelly Construction Co, Builders' Exchange Bldg, San Antonio, for pipeline system for municipal gas distribution, at $34,990. C A Harper, Brady Bldg, San Antonio, consulting engineer.

Sabinal plans municipal butane-gas plant and pipelines for distribution system. A bond issue will be voted soon.

Board of Education, Galveston, plans central-heating plant in new multi-story junior high school. Cost about $500,000. R R Rapp, Guarantee Bldg, architect.

Caldwell plans butane-gas plant and distributing pipeline system. Cost about $42,000. Bonds have been authorized. Joseph J Rady, Majestic Bldg, Fort Worth, consulting engineer.